

000687 / 42 DOE/RL 88-31 Volume 1

Draft Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1 Operable Unit Hanford Site, Richland, Washington

Environmental Engineering Group

Date Published March 1989



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Printed in the United States of America

DISCLM-2,CHP (2-89)

PREFACE

This preface is provided for the 300-FF-1 Workplan in order to better facilitate the regulatory review process. The 300-FF-1 Workplan was originally drafted based on the concept of a combined groundwater and source operable unit. The first draft, 300-FF-1 Workplan was reviewed by Westinghouse Hanford Company (WHC) and Pacific Northwest Laboratories (PNL) and the second draft by the U.S. Department of Energy- Richland Operations Office (DOE-RL) and its consultants under the assumption of the combined operable unit. However, during the DOE review cycle, it was formally determined that a 300 Area groundwater operable unit (300-FF-5) be established. The draft Tri-Party Agreement defines 300-FF-5 as a groundwater operable unit to be prepared as an addendum to 300-FF-1. The definition of the 300-FF-5 groundwater operable unit was not clearly defined until a meeting between WHC, PNL, DOE-RL, and the Environmental Protection Agency (EPA) on March 17, 1989 and subsequent clarification. The results of this definition was that 300-FF-5 would include most groundwater, surface water and sediments, and aquatic biota to become a "wet" operable unit consistent with the approach taken for the 100 Area Operable Units. However, based on EPA's suggestion, the 300-FF-1 Remedial Investigation (RI) would initially include some groundwater, surface water, and sediment analyses. The extent of this work will be determined as the 300-FF-5 Workplan is prepared and reviewed and results are obtained from the early 300-FF-1 RI. To provide the necessary information for this early work, and to provide a complete information base, the groundwater and surface water and sediment information originally provided in the 300-FF-I Operable Unit have been left in the text. Many of the DOE and subcontractor comments received regarding groundwater and surface water were not addressed in this version of the document, but deferred to the author of 300-FF-5. It is expected that regulatory personnel will review the 300-FF-1 Workplans with the proper perspective of the 300-FF-1/ 300-FF-5 Operable Unit interface.

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In order to simplify the document review, the text pertaining to groundwater and surface water and sediments has been italicized in the "Workplan" and "Field Sampling Plan." Comments received regarding groundwater and surface water and sediments will be forwarded to the authors of 300-FF-5 to produce a workplan meeting regulatory needs.

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ACRONYMS AND ABBREVIATIONS

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ACL
                      alternative concentration limit
         ams l
                      above mean sea level
         ARAR
                      legally applicable, or relevant and appropriate, environmental
                      standards, requirements, criteria, and limitations
         BOD
                      biochemical oxidation demand
         CEQ
                      Council on Environmental Quality
         CERCLA
                      Comprehensive Environmental Response, Compensation, and
                      Liability Act
         CFR
                      Code of Federal Regulations
         Ch.
                      Chapter
         Ci
                      curie
         CLP
                      Contract Laboratory Program
         CM
                      centimeter
        CRP
                      community relations plan
C 3
         d
                      day
        DMP
                      data management plan
(:)
        DNAPL
                      dense, non-aqueous phase liquid
                      U.S. Department of Energy
        DOE
        DOE-RL
                      U.S. Department of Energy--Richland, Washington
        EIS
                      environmental impact statement
        EM
                      electromagnetic
.
        EPA
                      U.S. Environmental Protection Agency
        FR
                      Federal Register
40
        FS
                      feasibility study
        FSP
                      field sampling plan
        ft
                      foot
                      gram
        g
        qal
                      gallon
        h
        HMS
                      Hanford Meteorological Station
\bigcirc
        HSP
                      health and safety plan
        in
                      inch
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        kg
                      kilogram
        km
                      kilometer
        L
                      liter
        16
                      pound
        m
                      meter
        mC i
                      millicurie
        MCL
                      maximum contaminant level
                      milligram
        mg
        mi
                      miles
        mL
                      milliliter
        mpn
                      most probable number
        NCP
                      National Oil and Hazardous Substances Pollution Contingency Plan
        NEPA
                     National Environmental Protection Act.
        ng
                      nanogram
        NPL
                     National Priorities List
        NTU
                     nephalometric turbidity unit
        ODC
                     other direct costs
```

PCB pCi PMP p/b	polychlorinated biphenyl picocurie project management plan part per billion
p/m	part per million
QΆ	quality assurance
QAPP	quality assurance project plan
QC	quality control
ROD	record of decision
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	remedial investigation
SAP	sampling and analysis plan
TOC	total organic carbon
TOX	total organic halogen
TSD	treatment, storage, or disposal
μg	microgram
μmho	micromho
UPR	unplanned release
USC	United States Code
WAC	Washington Administrative Code
wk	week
yr	year

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR THE 300-FF-1 OPERABLE UNIT

1.0 INTRODUCTION

Over 1,400 waste facilities have been identified on the Hanford Site. These include active treatment, storage, and disposal (TSD) facilities, subject to permit application and/or closure under the Resource Conservation and Recovery Act of 1976 (RCRA) and the Hazardous Waste Disposal Act, Revised Code of Washington (RCW). Inactive waste facilities subject to corrective action under RCRA or remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) are also included in the total figure.

Most of the waste facilities are located within geographic areas on the Hanford Site that are referred to as the 100, 200, 300, 400, and 1100 Areas. Figure 1-1 shows the location of these areas. The 600 Area includes the remainder of the Hanford Site that is outside the above designated areas. All waste facilities have been grouped into four aggregate areas (100, 200, 300, and 1100), each of which has been proposed for listing on the National Priorities List (NPL) under CERCLA. The four aggregate areas are subdivided into 21 waste area groups on the basis of facility and type of operation. Each waste area group is further subdivided into operable units on the basis of waste disposal practices, geology, hydrogeology, and other pertinent site characteristics. A total of 74 source operable units has been identified to date. This process is continuing, and the total number of operable units and the individual facilities within each operable unit are subject to change.

The purpose of this work plan is to document the project scoping process and to outline all Remedial Investigation/Feasibility Study (RI/FS) activities for operable unit 300-FF-1. The work plan was developed in accordance with: the statutory requirements of CERCLA, as amended, and the National Environmental Policy Act (NEPA); the regulatory requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Council on Environmental Quality (CEQ); and relevant U.S. Environmental Protection Agency (EPA) guidance documents. Such relevant EPA guidance includes:

- <u>Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA</u> (EPA, 1988b); and
- <u>Data Quality Objectives for Remedial Response Activities</u> (EPA, 1987a).

This chapter sets forth the general purpose, scope, and goals of the project. The structure of the work plan, and functions of the various chapters and attachments, are also outlined.

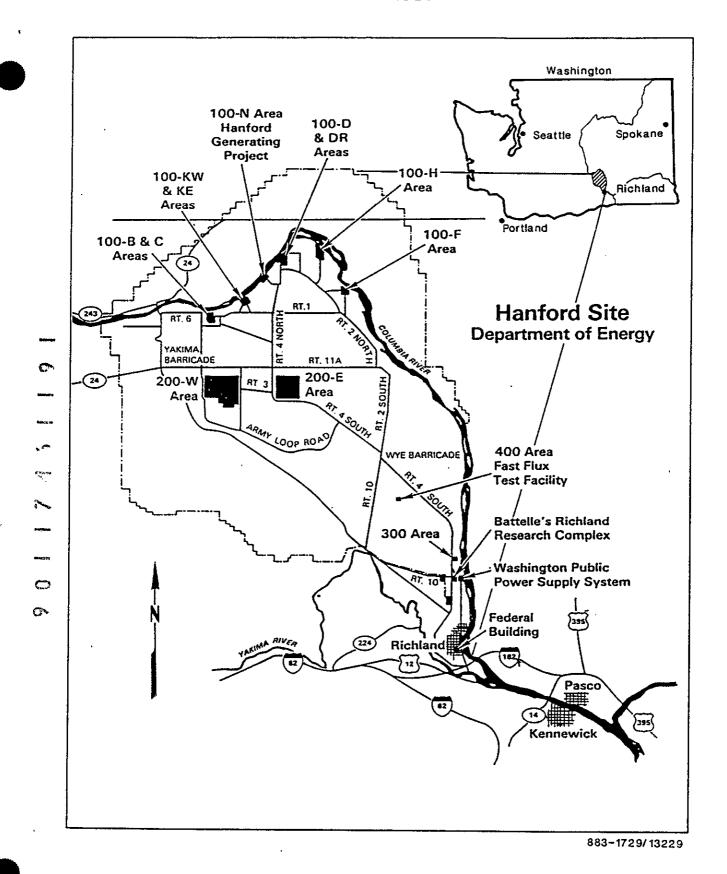


Figure 1-1. Hanford Site Map

1.1 PURPOSE AND SCOPE OF THE RI/FS

Pursuant to CERCLA, the EPA proposed the 300 and 400 Areas (the 300 Aggregate Area) at U.S. Department of Energy's (DOE's) Hanford Site for inclusion on the NPL on June 24, 1988. In anticipation of this proposal being finalized, DOE has divided the 300 Aggregate Area into operable units for the purpose of increasing the manageability of the site characterization and remediation processes (Stenner et al., 1988).

A cluster of nominated waste facilities is located within the 300 Aggregate Area. The 300 Aggregate Area has been further subdivided into five operable units, including 300-FF-1. The 300-FF-1 is known as a process liquid operable unit because it contains all of the liquid waste disposal facilities within the 300 Area (WHC, 1989). The DOE has assigned top priority to this process liquid operable unit due to documented groundwater contamination attributable to it.

The purpose of the RI/FS, in accordance with 40 CFR Part 300.68(d), is to determine the nature and extent of the threat presented by releases of hazardous substances from the operable unit, and to evaluate proposed remedies for such releases.

1.2 PROJECT GOALS

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The goal of the 300-FF-1 RI is to provide sufficient information needed to conduct the FS, by determining:

- the nature and extent of the threat, to public health and the environment, posed by releases of hazardous substances from 300-FF-1; and
- the performance of specific remedial technologies.

Such determinations will be carried out to the extent necessary and sufficient to allow for the evaluation of remedial alternatives during the FS.

The goal of the 300-FF-1 FS is to evaluate potential remedies that encompass a range of appropriate waste management options, by developing, screening, and analyzing remedial alternatives.

The ultimate goal of the RI/FS is to allow for the selection, for subsequent implementation, of a cost-effective remedial alternative that assures the protection of public health and the environment. After public review of the RI and FS reports, DOE, the EPA, and the Washington State Department of Ecology (Ecology), will select an appropriate remedy and document this choice in a record of decision (ROD). This will be followed by design, implementation, and monitoring of the chosen remedial alternative.

The RI/FS is divided into five phases--2 RI phases (operable unit characterization and treatability investigation) and 3 FS phases (remedial alternatives development, screening, and analysis). The RI and FS are conducted concurrently. The data collected in the RI provide the information needed to evaluate remedial alternatives in the FS; the FS, in turn, determines the data collection objectives for the RI.

Figure 1-2 shows how the RI/FS fits into the overall remedial action process. Each phase of the RI/FS, and its corresponding objective, is indicated.

1.3 ORGANIZATION OF WORK PLAN

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The work plan for the 300-FF-1 Operable Unit conforms with current draft guidance for RI/FS activities under CERCLA and the NCP (EPA, 1988b). It has been completed with current knowledge of conditions at the operable unit and may require modifications during the later phases of the project, once additional information becomes available and a better understanding of operable unit conditions is attained.

The work plan is intended to be a dynamic document which will be amended, as necessary, throughout the project. In this manner, the work plan will provide efficient and effective directions consistent with project goals. A dynamic work plan will also serve to help document the rationale for project decisions and conclusions, and thereby provide assistance in making subsequent remediation decisions.

The 300-FF-1 work plan also conforms, in part, with the CEQ requirements promulgated under NEPA. To a large degree, an RI/FS under CERCLA is functionally equivalent to an environmental impact statement (EIS) under NEPA. The work plan, the results of work performed pursuant to it, and subsequent remediation decisions will be circulated for public, federal agency, and state agency review to satisfy CEQ procedural requirements.

The work plan is based on the assumption that complete conformance with CEQ requirements will be achieved through the development of a supplemental, programmatic EIS. The programmatic EIS, encompassing all CERCLA activities on the Hanford Site, will address those environmental factors not normally relevant to an RI/FS. Such factors include assessments of impacts on regional energy and natural resources, transportation, and public services and utilities. Cumulative effects of environmental impacts will also be addressed in the programmatic EIS.

Seven chapters, in addition to this introduction, are included in the work plan. Chapter 2 presents the history and current understanding of the 300-FF-1 waste generation, transfer, storage, and disposal processes and facilities. The environmental setting for 300-FF-1 and its surroundings is also summarized.

Available data and potential contaminant exposure pathways are reviewed in Chapter 3 to develop a conceptual model for the operable unit. Waste sources, quantities, and characteristics are identified, along with the current understanding of the extent of contamination in the various environmental media. Legally applicable or relevant and appropriate environmental standards, requirements, criteria, and limitations (ARARs) for the various contaminants are identified, potential impacts to public health and the environment are assessed, and preliminary remedial action objectives are presented.

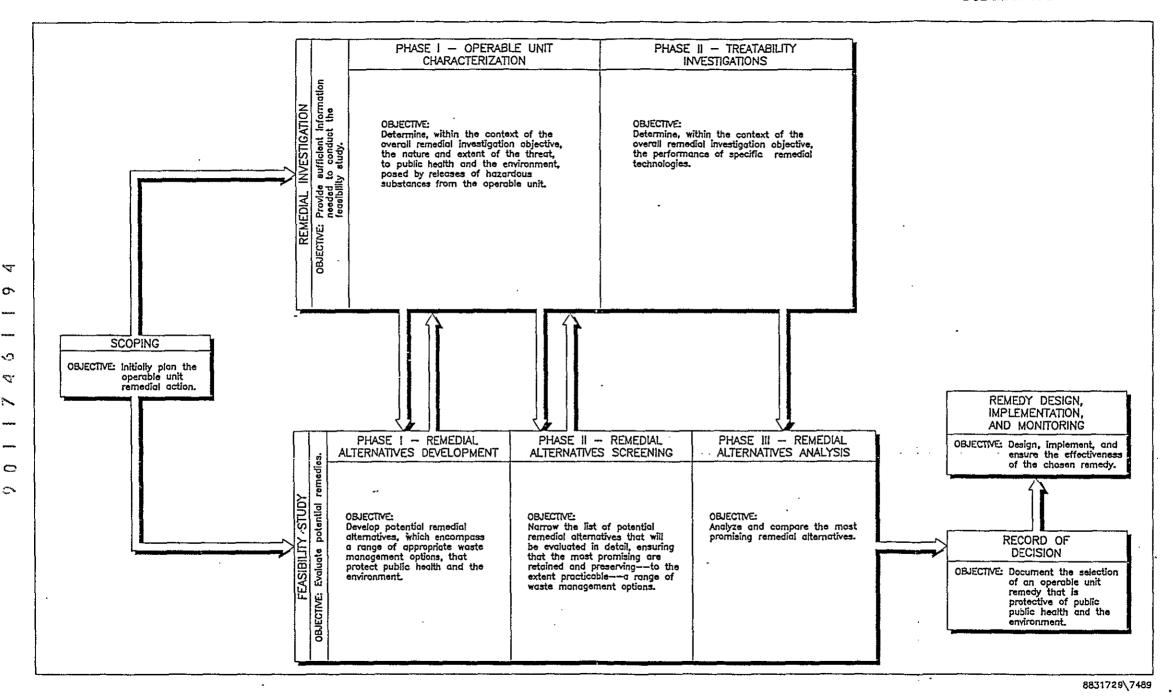


Figure 1-2. Remedial Action Process

Chapter 4 provides the rationale and objectives for RI/FS activities. Data needs and the data quality required to attain these objectives are defined.

Chapter 5 presents the tasks necessary to conduct the two phases of the RI and the three phases of the FS. Specific subtasks and activities for the treatability investigation are not set forth, because such activities will be dependent upon the information gathered during the operable unit characterization phase of the RI and the results of the initial phases of the FS.

A project schedule is presented in Chapter 6. Modifications to the schedule may need to be made as information is obtained during project implementation. Chapter 7 discusses project management responsibilities, and references for literature cited in the work plan are provided in Chapter 8.

There are five attachments to the work plan. These are:

- Attachment 1 Sampling and Analysis Plan
 la Field Sampling Plan
 lb Quality Assurance Project Plan
- Attachment 2 Health and Safety Plan
- Attachment 3 Community Relations Plan
- Attachment 4 Data Management Plan
- Attachment 5 Project Management Plan

Each plan was developed to be used in conjunction with the work plan and the other attachments, thus, minimizing duplication of information.

1.4 QUALITY ASSURANCE

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The basic objective of the Work Plan and its appended project plans is to ensure that the data and results or findings obtained are sufficiently accurate and reliable to support decisions associated with site evaluation, risk assessment, and evaluation and selection of remedial alternatives. In addition, all work on the Hanford Site is subject to the requirements of DOE-RL Order 5700.1A, Quality Assurance, which establishes broadly applicable quality assurance (QA) program requirements in compliance with ANSI/ASME NQA-1 guidelines (ANSI/ASME, 1986); the QA program requirements so defined apply to all types of project activities conducted on the Hanford Site.

To ensure that the objectives of the RI/FS are met in a manner consistent with DOE-RL Order 5700.1A, all work will be performed in compliance with Westinghouse Hanford's existing quality assurance manual and a QA program plan specific to CERCLA RI/FS activities. This QA program plan describes the various plans, procedures, and instructions that will be used by Westinghouse Hanford to implement the requirements of DOE-RL Order 5700.1A. The plan discusses areas such as the following:

- Management policies
- Organization charts and charters
- Management requirements and procedures

- Document clearance and information release
- Records management
- Quality audits and surveillances
- Operational health physics and radiological protection
- Emergency preparedness
- Standard engineering practices
- Radioactive and mixed solid waste packaging, storage, and disposal requirements
- Publication style
- Procurement

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Current EPA guidance for structure and content (EPA, 1988b) will be followed in the preparation of the RI/FS work plan and the supporting project plans. These plans will be prepared within the overall DOE-mandated QA program structure and will be supported and implemented through the use of standard operating procedures drawn from the overall program.

2.0 OPERABLE UNIT BACKGROUND AND SETTING

2.1 OPERABLE UNIT DESCRIPTION

2.1.1 Location

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Operable Unit 300-FF-1 is situated within the 300 Area of the Hanford Site in the south-central portion of the State of Washington. The 300 Area is located along the Columbia River at the southeast corner of the site, approximately 1.6 km (1 mi) north of the City of Richland in Benton County (Figure 2-1).

The 300-FF-1 Operable Unit is located immediately adjacent to the Columbia River in the northeast corner of the 300 Area (Plate 2-1), and covers an area of approximately 0.57 $\,\mathrm{km}^2$ (140 ac).

2.1.2 History of Operations

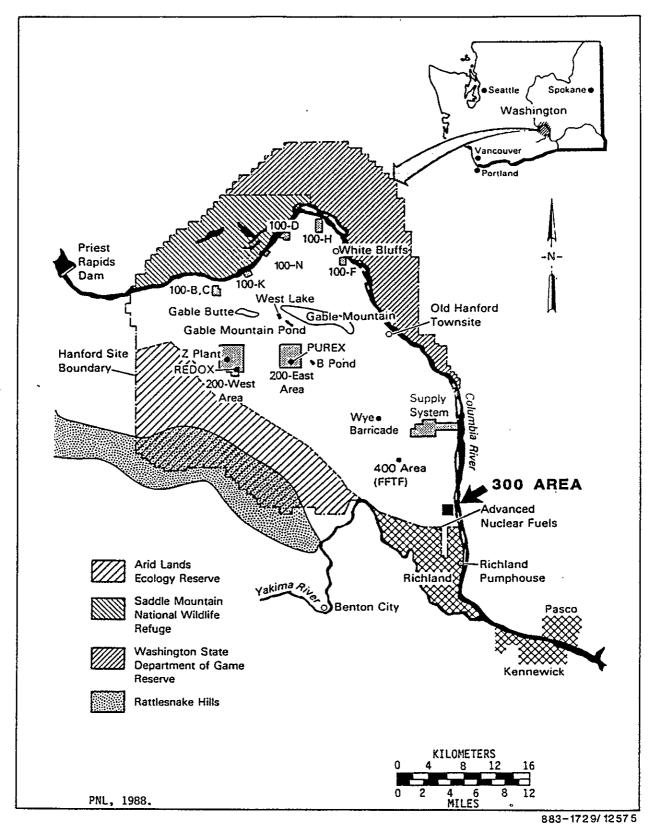
In 1943, after the Fermi experiment showed that nuclear fission could be controlled in a small reactor, the U.S. Army Corps of Engineers selected Hanford as the location to build larger versions of the Fermi reactor to produce plutonium for possible use in military weapons. Construction started in March 1943 on three reactor facilities, three chemical processing facilities, and the 300 Area--a fuel fabrication complex. The first of the reactors went into operation about 18 months after the start of construction, and the first plutonium was available some four months later.

After World War II, five reactors similar to those built during the war were constructed. A total of eight graphite-moderated reactors used the Columbia River for once-through cooling (i.e., water circulated through the reactors only once before being released back to the river).

Early in the 1950s, construction began on the research and development facilities, known as the Hanford Laboratories, in the 300 Area. This marked the first diversification of Hanford from a purely defense-materials production facility to one heavily involved in peacetime uses of the atom.

In 1963, the N Reactor was built. The N Reactor is different from the other eight reactors in that it can generate steam as a by-product of the plutonium production and does not need to use river water as a once-through coolant.

A presidential decision was made in early 1964 to begin shutting down the older Hanford reactors. This decision resulted in the closing down of all eight of the older reactors by the end of 1971, leaving the N Reactor as the only operational production reactor until it was recently placed on a cold standby status after operating through 1986.



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Figure 2-1. Location of the 300 Area within the Hanford Site

Initial construction at the 300 Area was completed in 1943. Most of the facilities in the area were involved in the fabrication of nuclear reactor fuel elements. In addition to the fuel manufacturing processes, many technical support, service support, and research and development activities related to fuel fabrication were and are carried out within the 300 Area.

As the Hanford Site production reactors have been shut down, fuel fabrication activities in the 300 Area have decreased. At the same time, research and development activities have increased, especially over the past two decades. The newer buildings in the area house primarily laboratory and large test facilities. Current research and development activities focus on peaceful uses of plutonium, reactor fuels development, liquid metal technology, fast-flux test facility support, gas-cooled reactor development, and life science research.

The 300 Area contains a number of support facilities, including a convertible oil/coal powerhouse for process steam production; a raw water intake, treatment, and storage facility; and other facilities necessary to support fuels production, research, and development.

Operable Unit 300-FF-I is known as a process liquid operable unit because it contains all the major past and present liquid waste disposal facilities for the 300 Area (Stenner et al., 1988). These disposal facilities are located within 90 to 500 m (300 to 1,600 ft) of the Columbia River.

2.1.3 Waste Generating Processes

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2.1.3.1 Process Wastes. Fuel elements are fabricated in the 300 Area by a coextrusion process. This process forms the zirconium cladding and the uranium/silicon fuel core from primary material components and bonds the two together in one operation. The fuel elements are protected with a copper jacket for the extrusion process. The jacket also prevents atmospheric contamination of the reactive fuel element, and the copper is easily lubricated for extrusion. Lubricants are removed using organic solvents such as trichloroethylene. After extrusion into billets, the copper is removed by dissolution into nitric acid (Stenner et al., 1988).

The uranium core is recessed by chemical milling so that the billets can receive an end cap. The chemical milling is performed using copper sulfate, nitric acid, and sulfuric acid. A zirconium end cap is then brazed on with beryllium. The fuel elements are tested for cap attachment, cap to core bonding, cladding to core bonding, and cladding to cap bonding before fuelelment supports and locking clips are attached (Stenner et al., 1988). Next, the tubes are autoclaved in steam to detect any perforations in the cladding or end caps. Finally, the elements are packed for storage and shipment (Stenner et al., 1988).

Prior to the late 1960's, aluminum-clad fuel was manufactured in the 300 Area as well, and thorium fuel fabrication was initiated in 1969 (Stenner et al., 1988).

Other chemicals routinely used in the fuel fabrication processes include (Douglas United Nuclear, 1967; Stenner et al., 1988):

- chromic acid,
- chromium trioxide,
- hydrofluoric acid,
- oxalic acid.
- phosphoric acid,
- potassium nitrite,
- sodium aluminate.
- sodium bisulfate,
- sodium carbonate,
- sodium dichromate,
- sodium fluorosilicate,
- e sodium alugarete
- sodium gluconate,
- sodium hydroxide,
- sodium nitrate,
- sodium nitrite,

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- sodium pyrophosphate, and
- sodium silicate.

The fuel fabrication processes also generated waste radioactive fission products, most of which were discharged to the radioactive liquid waste sewer system. Some of these substances, however, occasionally entered the process sewer. Radioactive isotopes known to be generated in the 300 Area include (Douglas United Nuclear, 1967):

- scandium-46,
- chromium-51,
- cobalt-58,
- iron-59,
- cobalt-60,
- zinc-65,
- zirconium/njobium isotopes.
- cesium-137,
- promethium-147.
- thorium-234,
- uranium isotopes, and
- plutonium isotopes.
- 2.1.3.2 Laboratory Wastes. Because many of the laboratory buildings in the 300 Area provided support for fuel fabrication process development, the wastes generated by these facilities are probably of a nature similar to that of the process wastes. However, with the wide variety of research and development activities pursued over the years, almost any chemical may have been discharged from these buildings in laboratory quantities (DOE, 1985). The fact that the 307 retention basins were constructed to hold laboratory wastes for pre-disposal radiological screening implies that the potential for radiological contamination of the laboratory waste stream was substantially greater than that for the process waste stream.
- 2.1.3.3 Miscellaneous Wastes. In addition to sanitary wastes from the 300 Area, the sanitary sewer system received an estimated 4 L/wk (1 gal/wk) of miscellaneous photochemicals from sign shop operations until 1985. Current sign and paint shop contributions consist of trace, nonhazardous

concentrations of carry-over fixers, developers, inks, thinners, solvents, and rinsewaters from the spray booth fume scrubbing system (DOE, 1989).

Filter backwash from the 300 Area water treatment plant can be expected to have elevated levels of alum (hydrated aluminum sulfate) (DOE, 1989). Alum is used as a coagulant/flocculent to remove suspended particles during the water treatment process.

Operation of the 300 Area convertible oil/coal powerhouse generates the flyash which is slurried to the 300-FF-1 ash pits.

Operational activities in the 300 Area generated solid wastes. Some of these solid wastes became contaminated with uranium and ended up being buried at burial ground #4 or burned, then buried, at burial ground #5. Operations of the liquid waste disposal ponds and trenches also resulted in the generation of contaminated solid wastes in the form of pond and trench sediments.

2.1.4 Waste Transfer, Storage, and Disposal Facility Characteristics

All of the 300-FF-1 waste transfer, storage and disposal facilities can be allocated among the following categories:

- process liquid waste transfer and disposal facilities,
- other liquid waste transfer and disposal facilities,
- burial grounds,

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- radioactive liquid waste transfer and storage facilities, and
- hazardous waste storage facilities.

Table 2-1 lists each of the 300-FF-1 facilities, its period of use and sources of wastes. Plate 2-2 shows the location of each facility within the operable unit. Any environmental sampling activities associated with each of the facilities are noted in the following discussions. Details on the results of such sampling activities are provided in Chapter 3.1.

2.1.4.1 Process Liquid Waste Transfer and Disposal Facilities.

2.1.4.1.1 Process Sewer System. The process sewer system was originally constructed in 1943 to transfer process liquid wastes (i.e., process sewage) from the various buildings in the 300 Area to the south process pond (316-1). The system was extended to serve the new north process pond (316-2) in 1948, modified in 1953 to allow for either simultaneous or alternating use of the south and north ponds, and extended once again in 1975 to transfer wastes to the currently active process trenches (316-5) (DOE, 1985).

The process sewer system is now connected to 43 buildings in the 300 Area (Table 2-2). The system is constructed of vitreous clay bell and spigot sewer pipes, 61 cm (24 in) in diameter along the main line, and it is possible that leakage may be occurring at many of the joints.

Table 2-1. Waste Disposal, Transfer, and Storage Facilities Included in Operable Unit 300-FF-1 (Sheet 1 of 2)

cess Liquid Waste Disposal Transfer Facilities	<u>Periods of Use</u>	<u>Waste Types</u>
Process Sewer System	1943-Presenț	Process sewage, i.e., cooling water, low-level radioactive wastes from fuel fabrication processes, laboratory and test-facility wastes, and process chemical spills.
South Process Pond (316-1)	1943-1975	Process sewage, water treatment plant filter backwash.
North Process Pond (316-2)	1948-1974	Process sewage, coal flyash.
307 Retention Basins	1953-Present	Laboratory sewage, i.e., cooling water, seal water, an laboratory and test-facility wastes.
307 Trenches (316-3)	1953-1963	Laboratory sewage, sediments from 316-1, coal flyash.
Process Trenches (316-5)	1975-Present	Process sewage.
her Liquid Waste Disposal and Transfer Facilities	Periods of Use	<u>Waste Types</u>
Sanitary Sewer System	1943-Present	Sanitary sewage, cooling water, minute quantities of photochemical process wastes.
Ash Pits	1943(?)-Present	Slurried coal flyash.
Retired Filter Backwash Pond (East Basin of South Process Pond)	1975-1987	Water treatment plant filter backwash.
Filter Backwash Pond	1987-Present	Water treatment plant filter backwash.

Table 2-1. Waste Disposal, Transfer, and Storage Facilities
Included in Operable Unit 300-FF-1 (Sheet 2 of 2)

Burial Grounds	Periods of Use	Waste Types
Burial Ground #4 (618-4)	1955-1961	Uranium-contaminated miscellaneous materials.
Burial Ground #5 (618-5)	1945-1962	Burning pit for trash, including uranium-contaminated trash.
North Process Pond Scraping Disposal Area (618-12)	1949-1964	Sediments from 316-2, coal flyash.
Radioactive Liquid Waste Transferred Storage Facilities	Periods of Use	<u>Waste Types</u>
Retired Radioactive Sewer System	1954-1975	Radioactive sewage, i.e., radioactive wastes from fuel fabrication, laboratory, and test-facility operations.
Radioactive Sewer System	1975-Present	Radioactive sewage.
340 Complex	1954-Present	Radioactive sewage.
Hazardous Waste Storage Facilities	Periods of Use	Waste Types
340 Complex Hazardous Waste Staging Area	1954-Present	Drummed waste oil storage, empty hazardous waste drum storage.
332 Hazardous Waste Staging Area	1983-Present	Small-container hazardous waste storage.

Table 2-2. 300 Area Buildings Connected to the Process Sewer System

303F	Chemical Pump House	
303J	Storage	
303K	Storage	
304	Construction Facility	
305	Hot Cell Verification Facility	
305A	Construction Office	
306E	Fabrication and Testing Laboratory	
306W	Metal Fabrication Development Building	
308	Fuels Development Laboratory	
309	SP-100 GES Facility	
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313	Steel House	
	Fuel Manufacturing Facility	
314	Engineering Department	
315	Filter Water Plant	
318	HTLT Reactor and Monitoring Service	
320	Low-Level Radiochemistry Building	
321	Hydromechanical Laboratory	
324	Chemical Engineering Laboratory	
325	Radiochemistry Laboratory	
326	Materials Technology Laboratory	
327	Post Irradiation Testing Laboratory	
329	Biophysics Laboratory	
331	Life Science Laboratory	
333	N Fuels Manufacturing	
335	Sodium Test Facility	
336	High Bay Test Facility	
337	High Temperature Sodium Facility and Offices	
338	300 Area Maintenance Facility	
382	Pump House	
384	Powerhouse	
3701D	Patrol Headquarters	
3705	Pacific Northwest Laboratory Photography	
3706	Information Services	
3707C	Automated Technology	
3708	Radiation Measurements	
3717B	Standards Laboratory	
3718F	Sodium_Storage	
3720	Central Service and Laboratory	
3722	Construction Shop	
3730	Gamma Neutron Irradiation Facility	
3732	Storage	
3745	Radiological Calibrations and Standards	
3746A	Radiological Physics Laboratory	

DOE, 1989

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In addition to process water from fuel fabrication operations, the process sewer system receives, or has received, cooling water, steam condensate, water treatment salts, and a wide variety of waste liquids from laboratory drains throughout the 300 Area. Due to the number of laboratories in the area, and the diverse nature of the research and development activities over the years, practically any chemical may have been discharged to the system--and subsequently to either the south process pond, the north process pond, or the process trenches--in laboratory quantities. Numerous chemical spills are known to have entered the process sewer system through the many floor drains in 300 Area buildings (DOE, 1985).

Some of the substances discharged to the process sewer were of a radioactive nature. Much of this burden to the system was removed in 1953 when a separate laboratory waste transfer and disposal system (the 307 system) was installed. The laboratory system was operated independently of the process sewer system until 1963. In 1963 the systems were reintegrated, but retention basins allow for screening of wastes too high in radioactivity for final disposal in the 300 Area (Douglas United Nuclear, 1967).

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Many unplanned releases are known to have entered the process sewer over the years. Most of these spills consisted of process wastes or chemicals and were ultimately routed to the disposal pond or trench in use at the time. Of the 37 documented unplanned releases assigned to 300-FF-1 Operable Unit, 32 were discharges to the process sewer system: UPR-300-37, -36, -35, -34, -33, -32, -31, -30, -29, -9, -28, -27, -26, -25, -24, -23, -22, -21, -20, -19, -15, -8, ten additional releases which occurred after 1980 (Stenner et al., 1988; DOE, 1989). These releases occurred in the period from 1972 through 1988. Releases of an unspecified amount of plutonium to the system in 1950, and 750 mCi of promethium-147 in 1967, are also known to have occurred.

Administrative controls were implemented in 1985 to eliminate all discharges of hazardous wastes to the process sewer system. Process sewage is analyzed monthly for operational purposes (DOE, 1985).

2.1.4.I.2 South Process Pond (316-1). An inactive, 0.03 km² (8 ac), unlined surface impoundment, the south process pond, located within the 300 Area perimeter fence in the southern section of the operable unit, was the first process liquid waste disposal facility for the 300 Area. It was constructed in 1943 and was operated until 1975. In addition to receiving wastes from the process sewer, the south pond received very small quantities of organic solutions through a stainless steel pipe running along the north dike. Prior to 1957, liquid wastes were also trucked to the pond for disposal (Dennison et al., 1988).

The pond structure varied over the years, but the final configuration consisted of a series of three small settling basins and two infiltration basins (Figure 2-2), each separated by dikes approximately 4.6 m (15 ft) high. The original inlet was located in the southwest corner of the pond; but in 1953 the process sewer modification, which allowed for either simultaneous or alternating use of the south and north process ponds, was installed with the inlet at the northwest corner of the pond (Dennison et al., 1988).

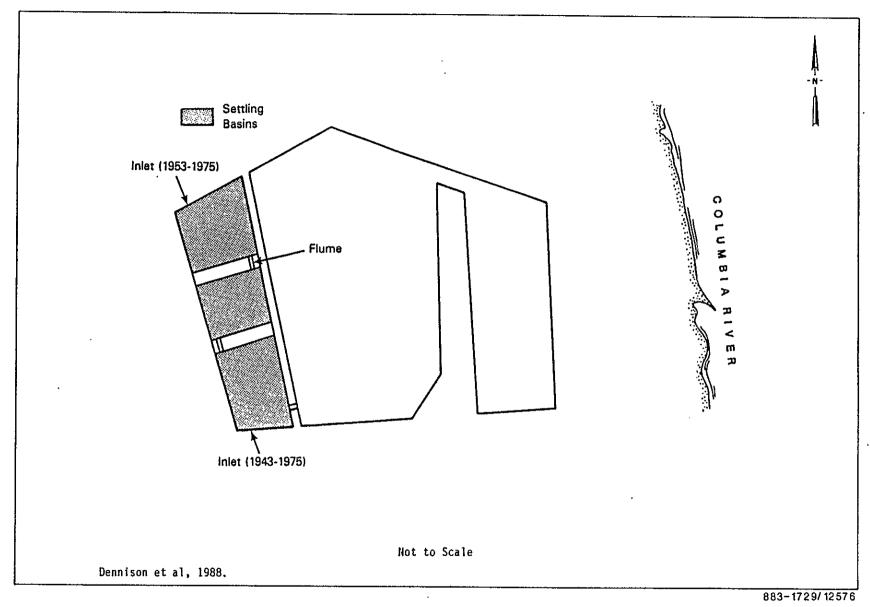


Figure 2-2. Final Operational Configuration of the South Process Pond

Process sewage entered the first of the settling basins and overflowed to the remaining basins through flumes in the tops of the dikes. This allowed suspended solids to settle. The pond had no outlet structure; final disposal in the infiltration basins occurred through infiltration and evaporation. The pond was periodically dredged to improve infiltration after a dike failure in 1948 resulted in an unplanned release to the Columbia River. Periodic dredging continued through 1969, when the production of aluminum-clad fuel ceased, ending the disposal of sodium aluminate which apparently precipitated in large enough quantities to restrict infiltration (Dennison et al., 1988).

Upon deactivation in 1975, the east infiltration basin was put into service as a filter backwash pond (Dennison et al., 1988; DOE, 1989). The dikes separating the settling basins and the west infiltration basin were partially removed at this time to provide cover for the pond sediments (Stenner et al., 1988).

South pond soils have been analyzed in 1974, 1975, and 1988 (Dennison et al., 1988). The groundwater monitoring network for the 300 Area also includes several wells in the vicinity of this pond (Schalla et al., 1988).

2.1.4.1.3 North Process Pond (316-2). The north process pond was constructed in 1948 after the dike in the south process pond failed. The pond is situated in the center of the operable unit outside of the 300 Area perimèter fence. In addition to receiving water from the process sewer, liquid wastes from fuel fabrication operations were trucked to the north pond through 1956. The north and south ponds were operated simultaneously or alternately until both were retired in 1975 (Dennison et al., 1988).

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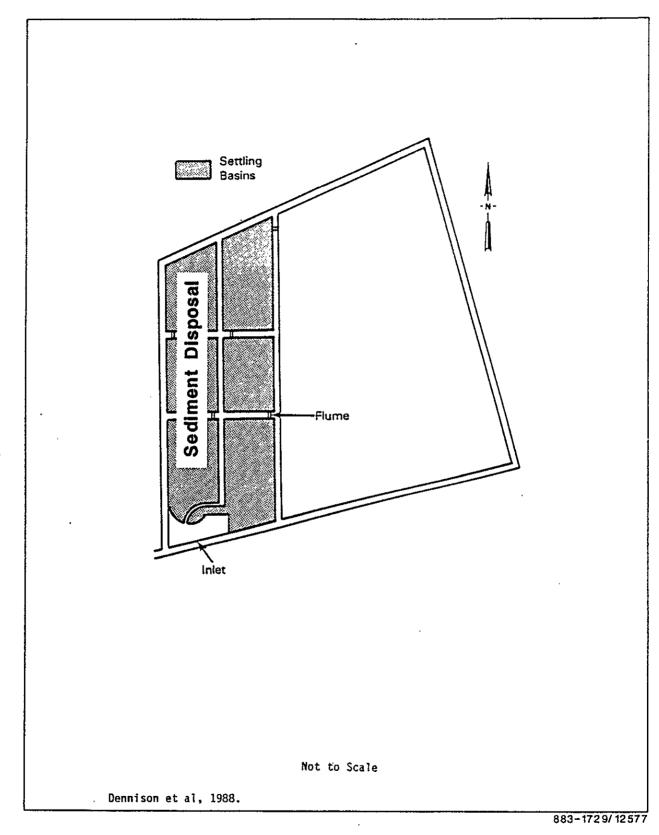
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The north process pond originally consisted of a single large infiltration basin. This basin was later subdivided into three small settling basins and one large infiltration basin (Figure 2-3). Flumes on top of 4.6 m (15 ft) high partitioning dikes interconnected the basins. The entire system covered approximately 0.04 km^2 (10 ac). The original three settling basins were replaced by three new basins in 1961/1962, and the original basins on the west side of the facility were retained for sediment disposal. The inlet for the pond was at the southwest corner (Dennison et al., 1988).

No outlet structure existed at the pond; the water would infiltrate or evaporate from the infiltration basin. Combined flows to the north and south process ponds ranged from 1,500 to 11,000 $\rm m^3/d$ (400,000 to 3,000,000 gal/d). The pond was periodically dredged to improve infiltration from 1948 through 1969. Dredged soils were spread on the dikes and buried in the adjacent north process pond scraping disposal area (Dennison, et al., 1988; Stenner et al., 1988).

After deactivation in 1975 some of the dikes were removed to provide cover for the basin soils, minimizing the potential for contaminant migration via fugitive dust. Parts of the north pond were used to dispose of flyash from the 300 Area ash pits (Dennison et al., 1988).

Soils from the north pond were sampled and analyzed in 1970 and 1988 (Dennison et al., 1988), and several groundwater monitoring wells are located nearby (Schalla et al., 1988).



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Figure 2-3. Final Operational Configuration of the North Process Pond

2.1.4.1.4 307 Retention Basins. The 307 retention basins were constructed in 1953, along with the 307 trenches, to accommodate the expansion of laboratory facilities in the 300 Area. They are located in the southeast corner of the operable unit, just south of the 340 complex. Buildings in the 300 Area which have connections to the 307 basins are listed in Table 2-3.

The 307 basins consist of four 95 m³ (25,000 gal) concrete retention basins where laboratory wastewaters can be held for analysis. If analysis showed the wastes to be below acceptable radiological discharge limits for ground disposal in the 300 Area before 1963, the wastes were transferred by pipe to the 307 trenches. After 1963, these wastes were routed to the process sewer system. If the wastes were determined to be above the radiological discharge limits, they were transferred to the 340 complex for tank storage. The acceptable discharge limit was 5,000 pCi/L and 1,000 pCi/L of total alpha and beta activity, respectively. No information on the integrity of this facility is available.

Because of difficulties with sampling, about 40 percent of the wastes received by the retention basins between 1953 and 1963, were released to the trenches without sampling. Because of this practice, it is possible that wastes exceeding discharge limits were unknowingly released to the trenches. Data for the period from 1953 through 1960, however, indicate that the discharge limits were never exceeded. Only radiological monitoring was performed; the chemical nature of the wastes was never determined.

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2.1.4.1.5 307 Trenches (316-3). The 307 trenches, or laboratory waste disposal trenches, are two parallel, inactive leaching trenches located at the southern boundary of Operable Unit 300-FF-1 within the 300 Area perimeter fence. The western portion of this former facility is also located within a fenced, high security area. These trenches were constructed in 1953 to dispose of laboratory and test-facility wastewaters from the 307 retention basins. Each trench was 150 m (500 ft) long by 6 m (20 ft) wide by 6 m (20 ft) deep. Flows to the trenches ranged from 110 to 380 m 3 /d (30,000 to 100,000 gal/d).

These trenches were retired in 1963. Upon retirement, the trenches were excavated and the bulk of the contaminated soils were disposed in the 300 north burial ground, which is located outside of the operable unit boundaries. In 1965, the trenches were used for the disposal of contaminated soils from the south process pond. These soils were then covered with flyash from the 300 Area ash pits. This facility is now backfilled and has a gravel surface, except for two storage buildings which occupy areas above the old trenches.

In 1987, a portion of the 307 trenches area was used for testing a liquid waste solidification process. A trench, 15 m (50 ft) by 6 m (20 ft) by 3 m (9 ft) deep was excavated. Discolored soils were encountered in the lower 2 to 3 feet of the excavation. The excavation was lined with a synthetic membrane liner and filled with a grout mixture of simulated liquid waste. The solidified grout was removed, along with samples of the liner, and the lined excavation was left open. Limited sampling of the exposed trench sediments was undertaken at this time, and the nearest groundwater monitoring well is located 46 m (150 ft) away.

Table 2-3. 300 Area Buildings Connected to the 307 Retention Basins

308 325	Fuels Development Laboratory Radiochemistry Laboratory
326	Materials Technology Laboratory
327 328	Post-Irradiation Testing Laboratory Mechanical Development Building
329	Biophysics Laboratory

DOE, 1989

С С 2.1.4.1.6 Process Trenches (316-5). The process trenches constitute the active liquid process waste disposal facility for the 300 Area. Located along the west boundary of the operable unit, outside the 300 Area perimeter fence, each of the two parallel leaching trenches is 460 m (1,500 ft) long by 3 m (10 ft) wide (at the trench bottoms) by 4.6 m (15 ft) deep, and was constructed in 1975. Slope failure has resulted in the formation of an approximately 46 m (150 ft) by 3 m (10 ft) extension lobe off the north end of the western trench. The two trenches are operated alternately, with the switching frequency ranging from two to six times per year. An inlet for each trench is located on the south end, and the discharge to the facility ranges up to 11,000 m 3 /d (3,000,000 gal/d)(DOE, 1985).

The wastes collected by the process sewer system discharge to the trenches via the inlet structure at the south end of the facility. The inlet structure is concrete and is approximately 21 m (70 ft) long by 3 m (10 ft) wide by 3 m (9 ft) high. Water from the process sewer flows toward both ends of the structure. At each end of the structure is an oil baffle and a sluice gate. The sluice gates control diversion of water to the trenches. The water flows through the sluice gate and down a concrete apron into the trench. There is no outlet for the trenches; all water either infiltrates or evaporates (DOE, 1985).

Current plans call for retiring this facility in the 1990's and replacing it with a process water treatment plant. Soil sampling in both trenches and in the soils of the partitioning berm occurred in 1987, and a groundwater monitoring network has been established around the facility (Schalla et al., 1988).

2.1.4.2 Other Liquid Waste Transfer and Disposal Facilities.

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2.1.4.2.1 Sanitary Sewer System. Sewage from the 300 Area is routed through vitreous tile pipes to septic tanks. Overflow from the septic tanks, in a volume of about 1,900 m 3 /d (500,000 gal/d), drains into one of two subparallel leaching trenches. The septic tanks and the 150 m (500 ft) long by 3.7 m (12 ft) wide trenches are located between the south and north process ponds within the perimeter fence for the 300 Area (DOE, 1989).

The date of construction for the sanitary trenches is unknown. The 300 Area plans, dated 1960, show the existing trenches; but plans from 1954 do not show the trenches, and they indicate that the septic tanks discharged to a now abandoned tile drain field situated beneath and to the north of the present location of the northern trench.

When the septic tanks are periodically cleaned, the solids are deposited in an adjacent sludge pit (Douglas United Nuclear, 1967). Several groundwater monitoring wells are located in the vicinity of the sanitary trenches (Schalla et al., 1988).

2.1.4.2.2 Ash Pits. Coal flyash from the convertible oil/coal power plant for the 300 Area is suspended in a water slurry and transported to the two ash pits within Operable Uñit 300-FF-1. These pits are 5 to 6 m (15 to 20 ft) deep and are located in the south-central portion of the operable unit, between the south process pond and the 307 trenches. About 57,000 m $^3/y$ (15,000,000 gal/y) of flyash slurry are deposited in the pits (DOE, 1989).

These pits are currently in use, but their date of construction is uncertain. A single ash trench in the same location shows up in site plans from 1954.

Once the flyash dries, it is currently hauled for disposal to a pit west of the 300 Area (DOE, 1989). In the past, these ashes have been deposited in areas of the north process pond and were used, in part, to backfill the 307 trenches (Dennison et al., 1988; Schalla et al., 1988).

Analyses of the flyash show it to be extraction procedure nontoxic (DOE, 1989). Flyash quality data are also available from the 1988 sediment studies of the north pond, because samples were obtained from areas of ash deposition (Dennison et al., 1988). There are several monitoring wells in the area, the closest being within 46 m (150 ft)(Schalla et al., 1988).

- 2.1.4.2.3 Filter Backwash Pond. This facility, located directly east of the ash pits within the 300 Area perimeter fence, was placed in operation in 1987. The pond receives about 190 m³/d (50,000 gal/d) of sediments from filter backwashing operations at the water treatment plant for the 300 Area. Sampling of the backwash indicates it is nonhazardous (DOE, 1989). Two of the 300 Area groundwater monitoring wells are located nearby (Schalla et al., 1988).
- 2.1.4.2.4 Retired Backwash Pond. This facility is the old east infiltration basin of the south process pond (Figure 2-2). When the south pond was retired in 1975, the east basin was used for disposal of 110 to 190 $\rm m^3/d$ (30,000 to 50,000 gal/d) of water treatment plant filter backwash. This basin operated in this capacity until 1987. The backwash water has been shown to be nonhazardous (DOE, 1989), and two groundwater monitoring wells are located close to the facility (Schalla et al., 1988).

2.1.4.3 Burial Grounds.

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2.1.4.3.1 Burial Ground #4 (618-4). Little information is available on this and the other two burial grounds within Operable Unit 300-FF-1. Burial ground #4 is located in the northwest corner of the operable unit, outside of the 300 Area perimeter fence. It was used from 1955 through 1961, and is only known to contain miscellaneous materials which are contaminated with uranium (Stenner et al., 1988). It is not known whether or not liquid wastes were disposed here.

In 1979, 20 depleted uranium fuel elements, composed of 0.15 percent uranium-235, were found to be improperly discarded near burial ground #4 (UPR-600-15). An area of approximately 37 $\rm m^2$ (400 $\rm ft^2$) was contaminated with radiation. The elements were removed, along with the contaminated surface soils, and disposed in the 200 West Area of the Hanford Site within two months of being discovered (Stenner et al., 1988).

2.1.4.3.2 Burial Ground #5 (618-5). This landfill is outside the 300 Area perimeter fence in the north end of the operable unit, just east of the northern end of the process trenches. This facility was a trash burning pit from 1945 through 1962. Some of the trash was contaminated with uranium (Stenner et al., 1988).

- 2.1.4.3.3 North Process Pond Scraping Disposal Area (618-12). This facility is adjacent to the south side of the north process pond. It was used from 1949 through 1964 to dispose of sediments from the pond, and flyash from the ash pits (Stenner et al., 1988).
- 2.1.4.4 Radioactive Liquid Waste Transfer and Storage Facilities.

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2.1.4.4.1 Retired Radioactive Sewer System. This pipeline, installed around 1954, received radioactive wastes from various buildings in the 300 Area, including the fuel fabrication and research and development laboratories. The wastes--primarily water with small quantities of various laboratory chemicals, decontamination solutions, fuel fabrication solutions, acids, and bases--were transferred through this system to the 340 complex for tank storage (DOE, 1989).

The piping system is constructed of stainless steel and is buried 3 m (10 ft) below the ground surface. The total length of the system is 1,200 m (4,000 ft), but not all of the system is located within Operable Unit 300-FF-1 (DOE, 1989).

This system was deactivated in 1975, and liquids within the pipes were drained prior to retirement. However, the pipes do contain residual radioactive contamination (DOE, 1989).

An unplanned release (UPR-300-1) occurred from this system in 1969. A carbon steel transition pipe corroded and failed between the 307 basins and the 340 complex, spilling radioactive materials into the soils 1.5 m (5 ft) below ground surface. Only the top 2 m (7 ft) of contamination were removed, to avoid jeopardizing the integrity of the adjacent structures (Stenner et al., 1988).

2.1.4.4.2 Radioactive Sewer System. Constructed in 1975 to replace the inactive system described above, this system consists of a double-encased sewer pipe of stainless steel surrounded by fiberglass-reinforced plastic. Continuous leak detection systems are in place between the inner and outer pipes. Flow rates through the system average about 1.1 $\rm m^3/d$ (300 gal/d) (DOE, 1989).

A radioactive spill from this system occurred in 1977 near the 340 complex (UPR-300-11). A connection to the sewer was found leaking, and the top 2.4 m (8 ft) of contaminated soils were removed for disposal (Stenner et al., 1988).

2.1.4.4.3 340 Complex. The 340 complex was constructed in 1954 to receive wastes from the retired radioactive liquid waste sewer system. The complex still operates in conjunction with the new radioactive liquid waste sewer system, which was installed in 1975. In addition to the 1.1 $\rm m^3/d$ (300 gal/d) waste stream received through the sewer, an additional 3 $\rm m^3/d$ (800 gal/d) of similar wastes were trucked in from N Reactor fuel fabrication activities (DOE, 1989).

Wastes transferred to the 340 complex are accumulated in stainless steel tanks. Two of these tanks are located below-ground and have 57,000 L (15,000 gal) capacities; six are above-ground and have 30,000 L (8,000 gal) capacities. The underground tanks are enclosed in a concrete vault with leak

detection systems. The above-ground tanks are enclosed in a building and situated in a concrete catchment basin. All tanks are continuously monitored for leaks and are alarmed to a constantly manned control panel (DOE, 1989).

Wastes are stored for less than 90 days before being transported to the 200 West Area for storage or disposal. Tank car loading takes place in an enclosed building with spill protection and containment systems (DOE, 1989). Before a rail spur was constructed to the complex, wastes were hauled out by truck. An unplanned release of decontamination wastes occurred from this facility in 1954 (UPR-300-2). A spill of phosphoric acid, on an unspecified date, is also known to have occurred at the 340 complex (Stenner et al., 1988).

2.1.4.5 Hazardous Waste Storage Facilities.

- 2.1.4.5.1 340 Complex Hazardous Waste Staging Area. This active staging area is located outside the 340 complex. It is used for temporary storage of about 20 to 30 empty drums each month. Some of these drums have contained hazardous materials. Drummed, nonregulated waste oils are also stored here. There have been no known releases from this area (DOE, 1989).
- 2.1.4.5.2 332 Hazardous Waste Staging Area. This active staging area is located in the central part of the operable unit, adjacent to the southwest corner of the north process pond scraping disposal area and outside the 300 Area fenced perimeter. The facility was put into use in 1983 (DOE, 1989).

Containers in storage are no more than 57 L (15 gal) in volume and typically consist of laboratory quantities of hazardous, nonradioactive, flammable liquids and solids, corrosives, reactives, extraction procedure toxics, toxics, and carcinogens. Wastes are stored either inside the small building or outside on a concrete pad. No known releases have occurred from this facility (DOE, 1989).

2.1.5 Unplanned Releases

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Details of documented unplanned releases to, at, or near waste facilities in the 300-FF-1 Operable Unit are presented in Appendix A. All unplanned releases, except UPR-300-14, have been associated with an operable unit waste facility in the above descriptions. As UPR-300-14 was a fully contained acid spill that occurred in 1975, did not result in a release to the environment, and was not associated with a 300-FF-1 waste facility (Stenner et al., 1988), it is given no further consideration with respect to this operable unit.

2.1.6 Interactions with Other Operable Units

Operable Unit 300-FF-1 is bordered on the west and south by Operable Units 300-FF-2, the 300 Area Solid and Buried waste Operable Unit, and by 300-FF-3, the central 300 Area Operable Unit (Plate 2-1). Operable Unit 300-FF-5, the 300 Area groundwater, surface water and sediment, and aquatic biota Operable Unit, underlies 300-FF-1, 300-FF-2, and 300-FF-3.

Operable Unit 300-FF-2, located west of 300-FF-1, is comprised predominantly of radioactive waste burial grounds. Most of the other sites

within the unit are unplanned releases within the 300 Area perimeter. Sites in this operable unit are considered to be sources of mixed wastes. There is no documentation of observed releases from 300-FF-2 facilities, but isolated instances of groundwater contamination have been detected in adjacent monitoring wells which cannot be linked directly to any specific facility (Westinghouse Hanford Company (WHC), 1989). Contaminated groundwater emanating from this operable unit would have the potential to migrate beneath Operable Unit 300-FF-1 toward the Columbia River.

The central 300 Area Operable Unit, 300-FF-3, borders 300-FF-1 on the south and west. This unit contains some unplanned releases and several hazardous materials handling facilities. Releases to the groundwater from this operable unit are similar in nature to, and probably not easily separated from, the contamination contributed from 300-FF-1 Operable Unit (WHC, 1989).

300-FF-5 encompasses all groundwater and surface water and sediments within the Columbia River contaminated by releases from waste facilities within 300-FF-1, 300-FF-2, and 300-FF-3. The creation of this operable unit eliminates problems associated with designating project boundaries that would result from the overlapping plumes of groundwater, surface water, and sediment contamination known to be emanating from the three source operable units.

Operable Unit 300-FF-4, the Fast Flux Test Facility or 400 Area, is separated geographically from the 300 Area (Figure 2-1). Therefore, no significant interactions between this and the other four 300 Aggregate Area Operable Units are anticipated. 300-FF-4 may therefore be regarded as a distinct waste site, administratively connected to the 300 Area with respect to CERCLA.

Because of the overlapping of contaminant extent within 300 Area Operable Units (300-FF-1, 300-FF-2, 300-FF-3, and 300-FF-5), a high degree of interaction between these operable units is anticipated. The RI/FSs for these operable units will not be scoped or implemented concurrently. Therefore, the last operable unit RI/FS implemented will need to ensure that all significant interactions are considered in selecting a final, overall remedy for the 300 Area.

2.1.7 RCRA Facility Interactions

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Two of the active facilities in Operable Unit 300-FF-1 fall under the jurisdiction of RCRA. A RCRA Part A permit application for the 332 hazardous waste staging area has been submitted to Ecology. A Part A permit application has been submitted to Ecology for the 300 Area process trenches, and Ecology has also requested that closure/post-closure permitting be conducted and that physical closure of this facility be initiated.

A closure/post-closure plan already exists for the process trenches (DOE, 1985), and is being updated. On February I, 1985, administrative controls were implemented by WHC to restrict disposal of dangerous or hazardous wastes to this facility. WHC plans to cease discharge to the process trenches as soon as practicable and is proceeding with an engineering study to identify the best available technology to replace the trenches. This facility will be closed under interim status.

A groundwater investigation in connection with the trenches (Pacific Northwest Laboratory (PNL), 1986) is underway. The process trenches appear to be responsible for most of the groundwater contamination emanating from the 300-FF-1 Operable Unit (Schalla et al., 1988). The RCRA groundwater investigation will be incorporated into the 300-FF-5 Operable Unit RI/FS. Additional source, geological, soil, air, and terrestrial biological data, pertinent to the process trenches operations or closure, will also be generated during the 300-FF-1 RI/FS. Data obtained from the RCRA groundwater investigation, and the 300-FF-1 and 300-FF-5 RI/FSs, will be evaluated to determine the most feasible closure and corrective action options for the process trenches. The goal is to integrate the RCRA closure of the trenches with the remedies selected under CERCLA for the 300-FF-1 and 300-FF-5 Operable Units.

2.2 OPERABLE UNIT SETTING

2.2.1 Topography

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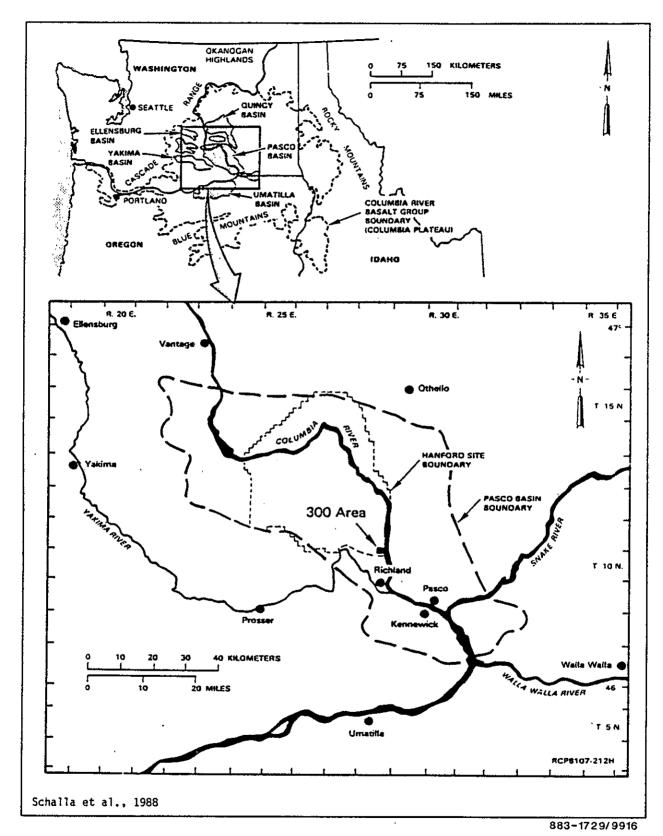
The 300 Area lies within the regional topographic low of the Pasco Syncline, a broad depression in the southeastern portion of the Pasco Basin (Figure 2-4). The site is situated immediately west of the free-flowing section of the Columbia River, below Priest Rapids Dam and above the headwaters of Lake Wallula behind McNary Dam. The elevation of the site is approximately 116 to 119 m (380 to 390 ft) above mean sea level (amsl). Surface topography at the site is generally flat and slightly irregular. The land surface slopes downward very gradually to the east and south. The Columbia River lies at an elevation of approximately 104 m (340 ft) amsl, forming a steep river embankment at the river's edge of approximately 12 m (40 ft) in height.

2.2.2 Geology

A general stratigraphic column of the Hanford Site is presented in Figure 2-5. This discussion, derived from Schalla et al. (1988), focuses on the principal lithologic units, distribution, and thicknesses of the geologic formations beneath the 300 Area.

The three uppermost stratigraphic formations beneath the 300 Area, in ascending order, are the Saddle Mountains Basalt Formation, Ringold Formation, and the Hanford formation. The general, uppermost stratigraphy of the 300 Area is shown in Figure 2-6. Geologic cross sections of the 300 Area are shown in Figure 2-7.

2.2.2.1 Saddle Mountains Basalt Formation. The Saddle Mountains Basalt is the uppermost formation of the Columbia River Basalt Group. This formation is characterized as dark gray to black basalt mixed with gray clay and caliche. The basalt exhibits a scoriacious texture with surface stains of iron and sulfide mineralization. The uppermost basalt flows in the area are the Goose Island flow of the Ice Harbor Member in the north and the Martindale flow of the Ice Harbor Member in the south.



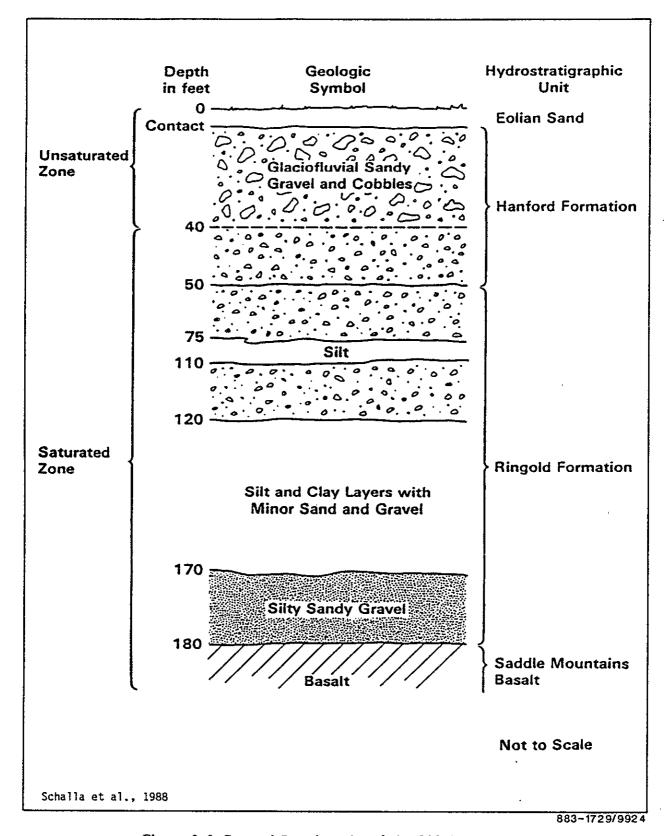
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Figure 2-4. Location of the 300 Area and the Hanford Site Relative to the Pasco Basin

/a*	DO 100 100 100 100 100 100 100 100 100 10	/ §/&	and is	Poporo Poporo	K. A.	Member or Sequence	Sediment Stratigraphy or Basalt Flows	
QUATERNARY	Pleistocene/ Holocene					Surficial Units	Loess Sand Dunes Alluvium and Alluvial Fans Landslides Talus Colluvium	
ĝ	Plaisto. cene			Hanford		Touchet Beds/ Pasco Gravels		
	Pilocene			Ringold			Plio-Pleistocene Unit Upper Ringold Middle Ringold Lower Ringold Basal Ringold	
	Missene				10.5	Ice Harbor Member	Goose Island Flow Martindale Flow Basin City Flow Levey Interbed	
				salt		Elephant Mountain Member	Upper Elephant Mountain Flow Lower Elephant Mountain Flow Rattlesnake Ridge Interbed	=
				nains Ba	12.0	Pomona Member	Upper Pomona Flow Lower Pomona Flow Selah Interbed]
TERTIARY		iali Group		Saddle Mountains Basalt	13.6	Esquatzel Member	Upper Gable Mountain Flow Gable Mountain Interbed Gable Mountain Interbed]
			Yakima Basali Subgroup	Sad		Asotin Member Wilbur Creek Member	Cold Creek Interbed : Huntzinger Flow	
						Umatilia Member	Wahtuke Flow Sillusi Flow Umatilla Flow	nation T
		River Bar		napum Basalt	13.5	Priest Rapids Member	Mabton Interbed Lolo Flow Rosalia Flows	Ellensburg Formation Tel
		fumbia F				Roza Member	Quincy Interbed Upper Roza Flow Lower Roza Flow	Ellensh
		ပိ		War		Frenchman Springs Member	Squaw Creek Interbed Aphyric Flows Phyric Flows]
				Grande Ronde Basalt	15.6	Sentinel Bluffs Sequence	Vantage Interbed Undifferentiated Flows Rocky Coulee Flow Unnamed Flow Cohassett Flow Undifferentiated Flows McCoy Canyon Flow Intermediate-Mg Flow	
					Grande	16.1	Schwana Sequence	Low-Mg Flow Above Umtanum Umtanum Flow High-Mg Flows Below Umtanum Very High-Mg Flow 1 .At Least 30 Low-Mg Flows

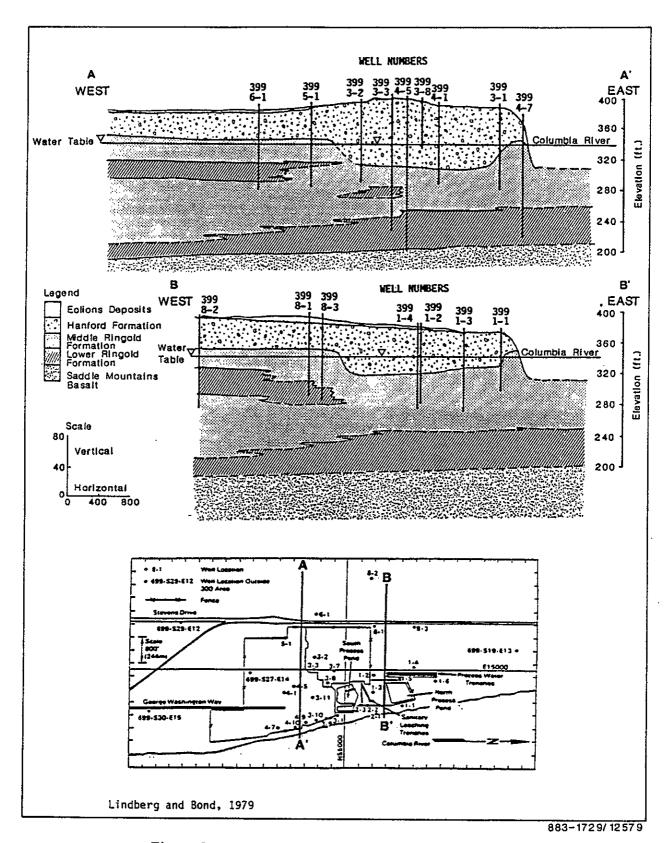
Figure 2-5. General Stratigraphic Column for the Hanford Site



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Figure 2-6. General Stratigraphy of the 300 Area



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Figure 2-7. Geologic Cross-Sections of the 300 Area

- 2.2.2.2 Ringold Formation. The Saddle Mountains Basalt is overlain by the Ringold Formation. In the 300 Area, the Ringold is composed of the basal, lower, and middle units, the upper unit having been largely removed by erosion subsequent to its deposition.
- 2.2.2.1 Basal Ringold. The basal Ringold is chiefly characterized as a well-consolidated clayey sand to a gravelly sand that varies in thickness from 0.6 to 5.2 m (2 to 17 ft) beneath the 300 Area. The clay fraction of this unit appears to be transitional from the overlying clay-dominated lower Ringold unit. The sand is primarily basaltic with some quartz and feldspar, and ranges from very fine to medium sized grains. The gravel fraction, only found locally, is dominantly basaltic with some granitic, quartzitic, and other metamorphic clasts. Calcium carbonate in the form of caliche is found locally at the basal Ringold-basalt contact.
- 2.2.2.2 Lower Ringold. The overlying lower Ringold unit consists of bluish-green clay, which gradually changes to brown clay/silt with depth. Very fine grained sand and silt stringers are locally encountered. The unit varies from 5 to 18 m (17 to 60 ft) in thickness at the 300 Area.

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- 2.2.2.3 Middle Ringold. The middle Ringold unit forms the top of the Ringold Formation beneath the 300 Area. This unit is characterized as moderately to well consolidated, brown-to-gray sandy gravel with local silt and sand lenses. The gravel fraction is represented by subangular-to-subrounded, pebble-to-cobble-sized clasts of basaltic, granitic, and metamorphic compositions. Although it appears to be a variable phenomena, a decrease in the percentage of basalt clasts is generally a useful tool in marking the contact between this unit and the overlying Hanford formation. Clast surfaces are moderately altered showing evidence of chloritization. The sand and silt are composed of quartz, feldspar, and mica with some basaltic and metamorphic rock fragments. The sand fraction is dominantly very fine to very coarse grained. This basaltic sedimentary unit is relatively consistent over the 300 Area, varying only from 20 to 26 m (65 to 86 ft) in thickness. The surface of the middle Ringold unit appears to be an irregularly shaped erosional surface.
- 2.2.2.3 Hanford Formation. Overlying the Ringold Formation is the unconsolidated, poorly sorted sediments of the Hanford formation. The composition of this formation is characterized as dark grayish-brown to dark olive-gray sandy gravel with some silt and local sand stringers. The upper portion of the unit generally exhibits a pebble-to-boulder gravel which grows finer with depth to a very fine-to-medium pebble gravel. The gravels of this unit are composed mainly of subangular-to-rounded basaltic clasts and also include a few quartz-rich and metamorphic clasts. The sands vary highly in composition but are predominantly basaltic. Calcium carbonate deposits are found on clast surfaces especially in the upper portion of the unit. Lenses of gravelly sand and pure sand occur locally. The thickness of the unit is quite varied, ranging from 6 to 25 m (21 to 81 ft).

The contact with the middle Ringold unit is determined by using particle size and by evidencing a predominance of basaltic sediments. Newcomb et al. (1972) summarized the main distinctions between the Pasco gravels of the Hanford formation and the underlying Ringold Formation. The Pasco gravels are basaltic in both the sand and the gravel fractions; generally less compacted, less indurated, and more permeable than the Ringold Formation; and the gravels

show no appreciable alteration. The Ringold Formation sands, however, are composed primarily of quartz; the gravels include such exotic rock types as granite, volcanic porphyry, and quartzite, and may show alteration rinds up to 0.3 cm (0.125 in) thick. In general, the Ringold sediments contain more silt and clay, even in the gravels.

- 2.2.2.4 Eolian Deposits. Overlying the Hanford formation in most areas of the 300 Area is a thin veneer of fine-to-coarse-grained, eolian (wind transported) sand deposits. The thickness of this deposit is quite varied, ranging from 0 to 4.6 m (0 to 15 ft). The lack of these deposits at some locations is a result of their removal from areas during construction activities over the last several decades. The geologic contact between the eolian deposits and the underlying Hanford formation is quite distinct.
- 2.2.2.5 Structure of the 300 Area. The 300 Area lies above the axis of the northwest-southeast trending Pasco Syncline shown in Figure 2-8. The syncline plunges gently northwestward toward the structural low of the Pasco Basin about 16 km (10 mi) to the northwest of the 300 Area. The basaltic bedrock surface along the synclinal axis beneath the 300 Area dips toward the northwest at a gradient of 4.8 m/km (25 ft/mi) or about 0.25 degree. Part of this dip may be related to the thinning and pinching out of the basalt flows, and the true dip of the individual flows may be slightly less than 0.25 degree. Ringold Formation sediments generally have dips similar to the underlying basalt; however, slightly lower dips prevail upward in the section.

Excavation in the 300 Area in 1958 disclosed the presence of a paleochannel incised into the Ringold Formation beneath the 300 Area (Lindberg and Bond, 1979). The channel is filled with glaciofluvial sediments and separated from the present channel by a levee of relatively less permeable Ringold sediments. More recent investigations have confirmed the presence of the paleochannel, which merges with the Columbia River somewhere north of the 300 Area and exits near the south end of the 300 Area.

2.2.3 Hydrogeology

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Unconfined and numerous confined aquifers are present beneath the 300 Area. The uppermost aquifer is unconfined; underlying aquifers are contained in the basal member of the Ringold Formation and the basalts, and are confined. The following discussion of the uppermost aquifer systems in the 300 Area is derived from Schalla et al. (1988). Additional details on the 300 Area hydrogeology will be provided in the 300-FF-5 Work Plan.

2.2.3.1 Confined Aquifer Systems. The confined aquifers in the basalts consist primarily of permeable zones at the contacts between basalt flows. The permeable zones, or interflow zones, are zones of fractured, jointed, brecciated vesicular basalt that occur at the upper and/or lower surfaces of the individual basalt flows and are the primary conduits for ground water. Sand or gravel interbeds may also be present in the interflow zones and serve as conduits for ground water. These aquifers are confined by the largely impermeable central or interior part of the basalt flows and by the low permeability siltstones and claystones of the interbedded sediments. The confined aquifer in the 300 Area referred to in this report is the sandy gravels of the basal member of the Ringold Formation that are probably hydraulically interconnected to the uppermost confined basalt aquifer.

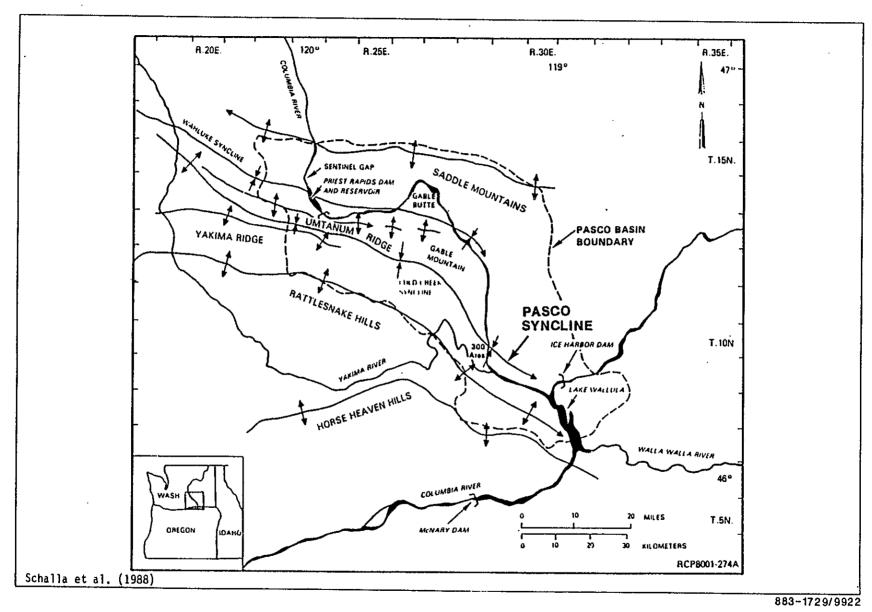


Figure 2-8. Location of Pasco Syncline

Much of the area near the axis of the Pasco Syncline is considered to be a discharge area for the confined aquifers, with ground water flowing upward from the uppermost basalt aquifers into the overlying unconfined sedimentary aquifer (Gephart et al., 1979). Measured hydraulic head differences across the confining lower Ringold, between the uppermost confined aquifer and the unconfined aquifer, ranges between 6 to 11 m (20 to 35 ft), thus indicating a large upward gradient.

Transmissivities of the basalt member vary from 0.15 to 9.3 m²/d (1.6 to $100 \, \mathrm{ft^2/d}$). Hydraulic conductivity and specific storage of the flow tops within the upper sequences of basalt (Saddle Mountain member) range from 0.003 to 300 m/d (0.01 to 1,000 ft/d) and from 3 X 10^{-7} to 3 X $10^{-5}/\mathrm{m}$ (1 X 10^{-7} to 1 X $10^{-5}/\mathrm{ft}$), respectively. The dense interiors of the basalt flows are both considerably less permeable and thicker than the flow contacts, and form confining layers. Sedimentary interbeds between successive lava flows generally consist of silts and clays with intermittent sand or gravel stringers. The majority (80 percent) of sedimentary interbeds within the upper basalts have moderate hydraulic conductivities ranging from 0.3 to 3 m/d (1 to 10 ft/d) (DOE, 1988).

2.2.3.2 Unconfined Aquifer System. In the 300 Area, the water table (the upper surface of the unconfined aquifer) is in the galciofluvial sediments of the Hanford formation. The lower part of the unconfined aquifer is the middle member of the Ringold Formation and may be partially confined by the thin interbeds of silt and clay. The water table is at a depth of about 40 ft below the land surface, and the top of the Ringold Formation is at a depth of 35 to 65 ft.

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The Hanford formation in the 300 Area consists of unsaturated sandy gravel with few cobbles and boulders in the upper half of the unit and saturated sandy gravel with more cobbles and boulders in the lower half. These sediments vary from 9 to 26 m (30 to 85 ft) in thickness. The transmissivity is consistently high, varying from 3,700 to 9,500 m²/d (40,000 to 102,000 ft²/d). Most of the transmissivity in the unconfined aquifer in the 300 Area has been attributed to the sediments of the Hanford formation; however, recent tests indicate that the transmissivity attributable to the uppermost middle Ringold sediments is similar, varying from 930 to 19,000 m²/d (10,000 to 200,000 ft²/d).

The sandy gravels of the lower Ringold are probably semiconfined beneath some portions of the area due to layers of silt and clay acting as aquitards. Transmissivities in the lowermost portion of the middle Ringold range from 0.7 to 19 m²/d (8 to 200 ft²/d).

Hydraulic properties of the water table aquifer vary considerably with location due to changes in local stratigraphy. The hydraulic conductivity of the unconfined aquifer generally decreases with depth. The very broad ranges of measured hydraulic conductivity and storativity within the principal stratigraphic horizons at the Hanford Site are summarized in Table 2-4. A large scale effective porosity of 0.11 has been estimated for the Ringold Formation in the vicinity of the 200 Area (Newcomb et al., 1972).

Table 2-4. Hydraulic Properties of Unconfined Aquifer in Pasco Basin

STRATIGRAPHIC HORIZON	HYDRAULIC CONDUCTIVITY (FT/DAY)	STORAGE COEFFICIENT
Hanford Formation	500 - 20,000	0.03 - 0.20
Undifferentiated Hanford and Middle Ringold	100 - 7,000	
Middle Ringold	20 - 600	0.0002 - 0.05
Lower Ringold	0.1 - 10	0.002 - 0.05

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Natural recharge of the unconfined aquifer beneath the Hanford Site occurs at the northwest margin of the Pasco Basin. An artificial recharge occurs at the 200 Area near the center of the Hanford Site. Ground water flows from these recharge areas toward the 300 Area in a general southeasterly direction. In the southeast corner of the Hanford Site, ground-water recharge is mainly from the Yakima River. The 300 Area is located approximately at the point where these two ground-water sources meet. As a result, ground water enters the 300 Area from the northwest, west, and southwest (Lindberg and Bond, 1979). A contour map of the water table surface for the Hanford Site is shown in Figure 2-9.

In the 300 Area groundwater generally flows toward the river to the southeast (Figures 2-10 and 2-11). The exact direction of groundwater flow at any given time, however, is determined by both natural and man made influences. The primary influence is the level of water in the Columbia River. Lindberg and Bond (1979) verified that when the river stage rises during spring run-off, bank storage occurs and causes a reversed water table gradient in the 300 Area. During these times, ground water tends to flow in a more southerly direction, roughly subparallel to the river as shown in Figure 2-12. When the river level drops, the natural gradient is restored and ground water flows more easterly in a direction nearly perpendicular to the river.

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Effect of river fluctuations have been measured up to 4 km (2.5 mi) from the river, but are dampened with distance from the river. A 1.2 m (4 ft) increase in river elevation between May 20 and 27, 1977, was of sufficient duration to create a gradient reversal, resulting in the groundwater levels over much of the central portion of the 300 Area being lower than the surrounding areas (Lindberg and Bond, 1979). Measurements of changes in groundwater elevation during and subsequent to that period are shown in Figures 2-13 to 2-16. These changes are merely illustrative of the magnitude and timing of changes that can be anticipated. Measurements of groundwater temperature during this period, however, suggest that the amount of river water which invaded the aquifer was probably small, indicating that the increase in elevation of the river creates a hydraulic barrier.

Lindberg and Bond (1979) suggest that the former river channel (paleochannel) discovered in 1958 is responsible for the rapid response of the ground-water levels and contaminant movement to changes in the hydraulic gradient, because the Pasco Gravels within the channel are more permeable than the surrounding Ringold Formation. The former channel extends north and south of the 300 Area, and a breach in the natural levee separating the old channel and the current Columbia River channel has been proposed to account for the higher flow rate between the trenches. Probably many breaches and few barriers separate the channels as evidenced by irregular water level contours along the river bank, shown in Figure 2-10 at lower water levels and Figure 2-12 at higher water levels.

The primary man made influence on groundwater levels and flow directions in the 300 Area is from the process trenches. Discharge to the trenches is up to $11,000~\text{m}^3/\text{d}$ (3,000,000 gal/d). Discharge to the nearby sanitary trenches range up to 1,900 m³/d (500,000 gal/d). These large volumes of water percolate quickly to the groundwater and create small groundwater mounds on the water table surface. The mounds increase the water table gradient and produce divergent flow particularly around the process trenches.

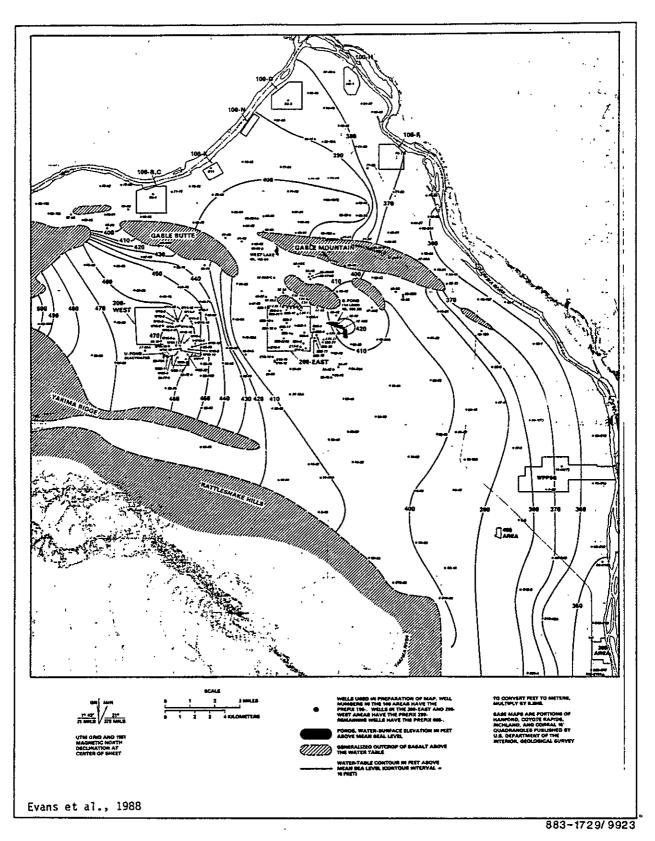
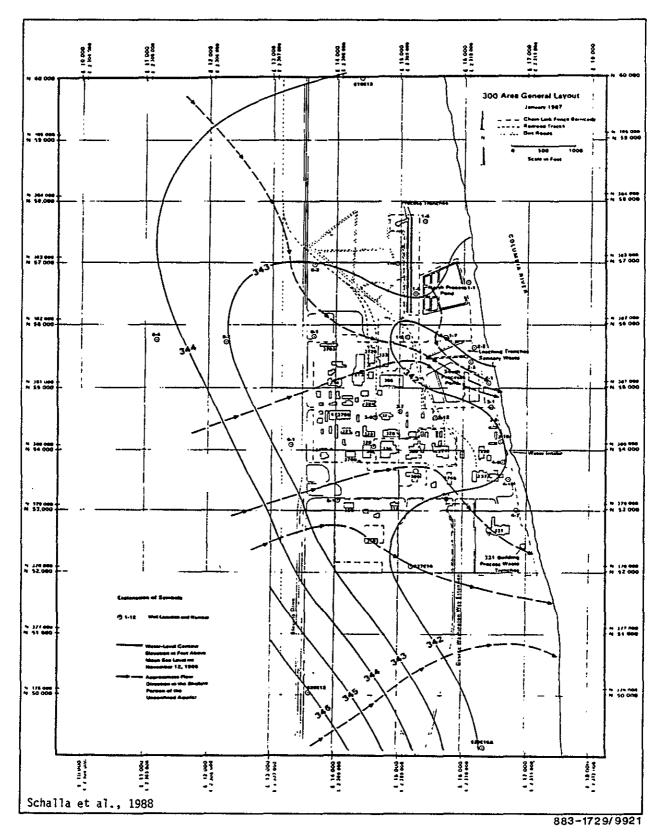


Figure 2-9. Unconfined Aquifer Water Table Map, December, 1984



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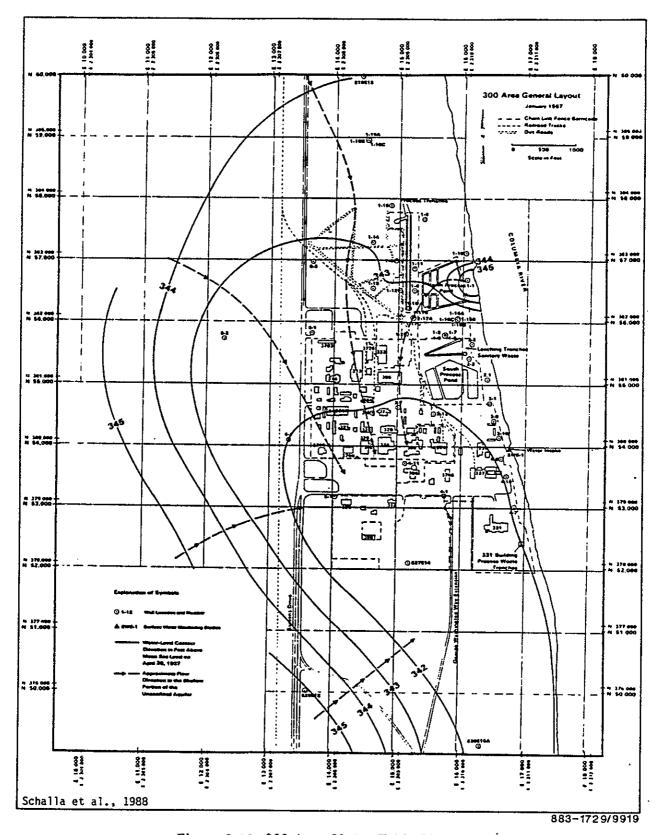
Figure 2-10. 300 Area Water Table Map, November 1985

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Figure 2-11. 300 Area Water Table Map, August 1986



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Figure 2-12. 300 Area Water Table Map, April 1987

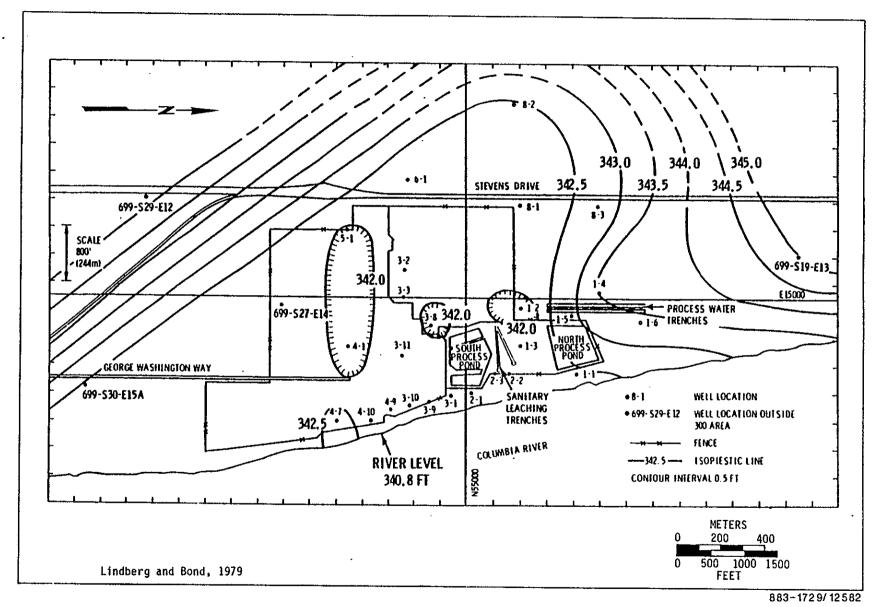


Figure 2-13. 300 Area Water Table Map, May 20, 1977

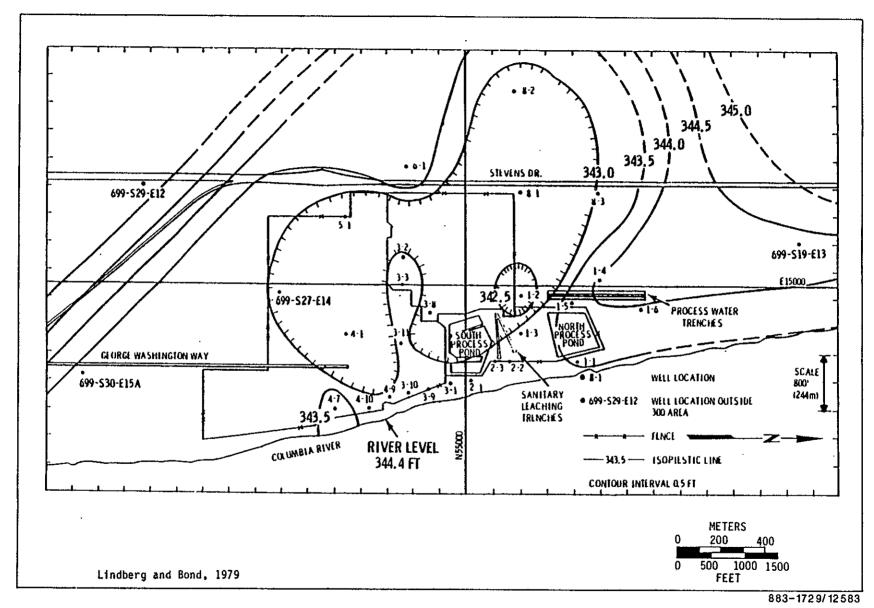


Figure 2-14. 300 Area Water Table Map, May 27, 1977

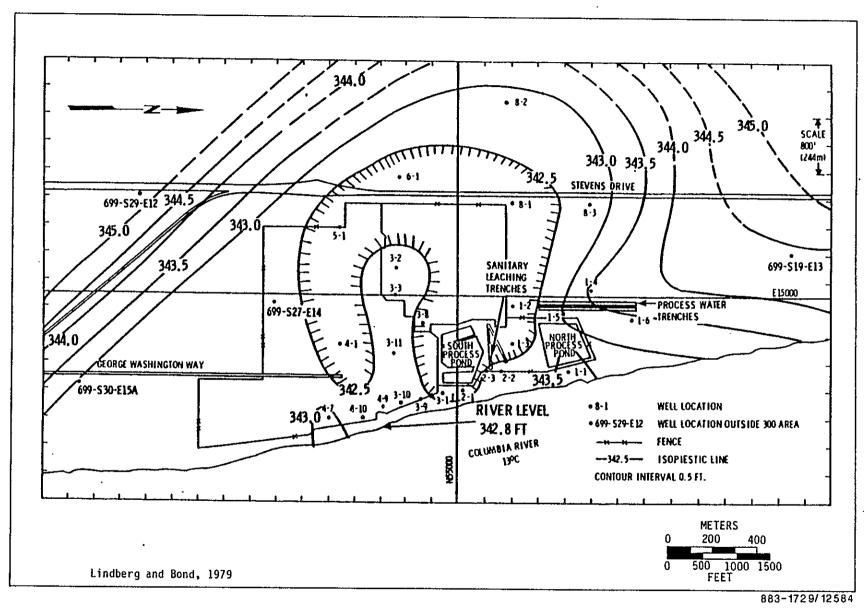


Figure 2-15. 300 Area Water Table Map, June 3, 1977

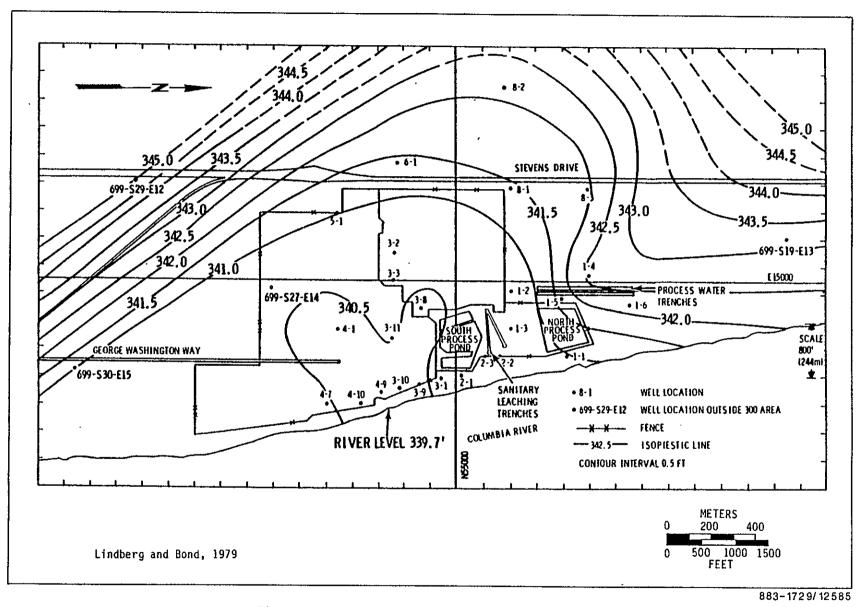


Figure 2-16. 300 Area Water Table Map, July 1, 1977

2.2.3.3 Vadose Zone. The thickness of the vadose zone ranges from less than 0.3 m (1 ft) near the Columbia River to over 137 m (450 ft) in the eastern portion of the Pasco Basin. Water contents at depth in vadose zone sediments at the Hanford Site are generally low, ranging from 2 to 7 percent by weight in coarse and medium grained soils and 7 to 15 percent in silts (Gee and Heller, 1985). Measurements of matric potential—the energy required to extract water from a soil against the capillary and adsorptive forces of the soil matrix—at depths greater than 9 m (30 ft) suggest that water in the deeper sediments is slowly draining to the water table (Hseih et al., 1973).

Beneath the 300 Area, the vadose zone is general about 12 to 15 m (40 to 50 ft) thick and lies nearly entirely within the Pasco Gravels of the Hanford formation. Lysimeter and field studies near the 300 Area, conducted between 1979 and 1984, indicate the water is moving downward at depth below the plant root zone. Estimates of recharge rates are 3 to 8 cm/y (1 to 3 in/y) for grass-covered soils (Kirkham and Gee, 1984) and over 5 cm/y (2 in/y) for bare soil (Jones et al., 1984). Coarse grained soils, shallow-rooted plants, and above normal precipitation during the measurement period, have enhanced recharge estimates at this location (Gee and Heller, 1985).

2.2.4 Hydrology

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Apart from the Columbia River and man-made impoundments, no surface water exists at the 300-FF-1 Operable Unit. Normal precipitation is insufficient to generate surface runoff with the possible exception of paved areas. Small groundwater seeps are observed along the river embankment.

The free flowing section of the Columbia River adjacent to the 300 Area ranges in width from 370 to 550 m (1,200 to 1,800 ft) and has a maximum depth of 3 to 12 m (10 to 40 ft). Average annual flow is 3,400 m 3 /s (120,000 ft 3 /s) with daily flows ranging from 1,000 to 16,000 m 3 /s (36,000 to 550,000 ft 3 /s). Peak flows occur during spring runoff periods. The discharge of this reach of the river is controlled mostly by Priest Rapids Dam. The McNary Dam, located downstream, also has some minimal influence.

Much of the bed of the Columbia River is heavily armored, with numerous cobbles on boulders lying on the surface of the substrata.

Additional details on the hydrology of the Columbia River near the 300 Area will be provided in the 300-FF-5 Work Plan.

2.2.5 Meteorology

Climatological data for the Hanford Site are published in Stone et al. (1983). Meteorological measurements have been made at the Hanford Meteorology Station (HMS) (located between the 200 Areas in the central portion of the site) since 1945, and temperature and precipitation data from a nearby location are also available for the period from 1912 through 1943. Beginning in the late 1970s, automated monitoring stations were deployed at selected locations on the Hanford Site. As part of this program, a 9 m (30 ft) instrumented tower was erected several hundred meters southwest of the 300 Area. In 1983, the 9 m (30 ft) tower was replaced by a 61 m (200 ft) instrumented tower. Wind direction, wind speed, and air temperatures are

measured at three levels on the 61 m (200 ft) tower. Data are transmitted from the tower to the HMS every 15 minutes for processing and storage.

2.2.5.1 Wind. Prevailing wind directions at the 300 Area are from the southwest and northwest (Figure 2-17). During the spring, summer, and fall, winds from the southwest occur most frequently. During the winter, winds with components from the northwest occur most frequently. The average annual wind speed is approximately 12 km/h (7.5 mi/h); monthly average wind speeds are lowest during the fall and highest in the spring. The highest wind speeds are usually associated with winds from the southwest. In the summer, high speed winds from the southwest are responsible for most of the dust storms in the region.

High winds are also associated with afternoon drainage winds and thunderstorms. The summertime drainage winds are generally northwesterly and frequently reach 50 km/h (31 mi/h). An average of ten thunderstorms occur each year, usually during the summer, and the winds associated with them do not display a directional preference (DOE, 1987).

2.2.5.2 Temperature and Humidity. Average monthly temperatures at the HMS range from a low of -4.4 C (24 F) in January to a high of 24.4 C (76 F) in July. The lowest recorded monthly average winter temperature is -5.9 C (21 F), and the highest recorded monthly average winter temperature is 6.9 C (44 F); both of these records were set during February. The highest recorded monthly average summer temperature is 27.8 C (82 F), which occurred during July. The coolest summer month on record is June at 17.2 C (63 F).

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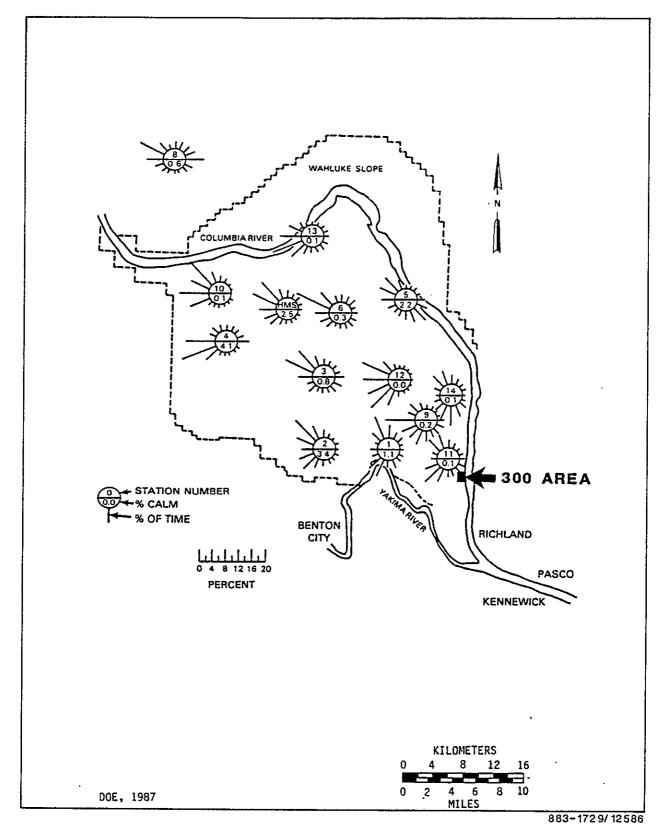
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The annual average relative humidity at the HMS is 54 percent. Humidity is higher than the annual average during the winter (averaging about 75 percent), and lower than the annual average during the summer (averaging about 35 percent) (DOE, 1987). Average relative humidities may be slightly higher in the 300 Area because of the proximity of the Columbia River and irrigated farm land.

2.2.5.3 Precipitation. The Hanford Site is located within a rain shadow formed by the Cascade Mountains to the west. The average annual precipitation at the HMS is 16 cm (6.3 in). The total annual precipitation ranges (0.01 to 0.99 quantiles) from 8 to 28 cm (3 to 11 in). Most of the precipitation takes place during the winter, with nearly half of the annual amount occurring from November through February.

Winter monthly average snowfall ranges from 0.8 cm (0.3 in) in March to 13.5 cm (5.3 in) in January. The record snowfall of 62 cm (24 in) occurred in February 1916, but the second highest snowfall is less than half this amount.

Days with precipitation events greater than 1.3 cm (0.50 in) of precipitation occur with a frequency of less than 1 percent during the year. Rainfall intensities of 1.3 cm/h (0.50 in/h) persisting for one hour are expected once every ten years. Rainfall intensities of 2.5 cm/h (1.0 in/h) for one hour are expected only once every 500 years.



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Figure 2-17. Wind Roses for the Hanford Telemetry Network, 1979-1982

2.2.5.4 Evapotranspiration. The mean annual pan and lake evaporation values for the Tri-Cities region near the Hanford Site are approximately 140 cm (55 in) and 102 cm (40 in), respectively. Approximately 79 percent of annual evaporation occurs in the six month period from May to October (Weather Bureau, 1966).

Mean annual potential evapotranspiration for the region has been estimated to be about 74 cm (29 in). The actual evapotranspiration rate is estimated to be about 18 cm (7 in) (Weather Bureau/Department of Agriculture, 1962). The evapotranspiration rate for the 300 Area may be less, due to the porous soils and sparse vegetative cover.

2.2.6 Environmental Resources

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The flora, fauna, sensitive environments and critical habitats, land use characteristics, and water use characteristics for the 300-FF-1 environment. are discussed below. Additional details on the aquatic biology of the Columbia River near the 300 Area will be provided in the 300-FF-5 Work Plan.

2.2.6.1 Flora. The semiarid bench above the Columbia River, on which most of Operable Unit 300-FF-1 lies, has been subjected to various landscape manipulations as a result of 300 Area construction and operation activities. The natural vegetation consists mostly of a sparse covering of desert shrubs and drought-resistant grasses. The predominant vegetation type is the big sagebrush/cheatgrass/bluegrass community. Bitterbrush and rabbitbrush are also common shrubs (PNL, 1987; DOE, 1987). A narrow riparian zone, consisting of herbs interspersed with a few scattered deciduous shrubs and trees, exists along the Columbia River.

Table 2-5 includes the federal designated threatened flora species which could potentially occur in or near 300-FF-1--the Thompson's sandwort. Two proposed threatened plants, Hoover's desert parsley and the Columbia milk-vetch, and a proposed endangered riparian species, persistent sepal yellowcress, are also included in the table.

2.2.6.2 Fauna. Predominant fauna of the sagebrush/grass community that could potentially reside in or near the operable unit are the cottontail, jackrabbit, Great Basin pocket mouse, horned lark, and the western meadowlark. Mule deer, coyotes, and various species of raptors forage in this habitat type, and grasshoppers are the most conspicuous insects in the community (DOE, 1987). Dominant riparian fauna include muskrat, porcupine, racoon, quail, pheasant, and waterfowl. Waterfowl have been known to seek refuge in the 300 Area process trenches (PNL, 1987), and Great Basin Canada geese frequent the islands in the Columbia River which are located near the operable unit.

The Columbia River provides a habitat for a wide diversity of fish. Important game species are chinook salmon, steelhead, coho salmon, sockeye salmon, smallmouth bass, largemouth bass, sturgeon, walleye, yellow perch, and channel catfish. The Hanford reach of the Columbia River sustains a spawning population of fall chinook salmon. Increases in this population over the years are responsible for attracting numerous bald eagles to the area in the fall and winter to feed on the dead salmon (DOE, 1987).

Table 2-5. Endangered and Threatened Species* Potentially Associated with the 300 Area

<u>Species</u>	<u>Notes</u> <u>Endangered Species</u>			
American white pelican <u>Pelecanus</u> <u>erythrorhyncus</u>	Forages on the Hanford reach of the Columbia River in fall and winter.			
Peregrine falcon <u>Falco peregrinus</u>	An erratic visitor.			
Proposed Endangered Species				
Columbia River tiger beetle Cincindela columbica	Believed to inhabit the sandy shores of the Hanford reach of the Columbia River.			
Persistent sepal yellowcress <u>Rorippa</u> <u>columbiae</u>	This plant inhabits the wetted shoreline of the Hanford reach of the Columbia River.			
<u>Threatened Species</u>				
Townsend's big-eared bat Plecotus townsendii	Potential inhabitant of caves or abandoned buildings.			
Bald eagle <u>Haliaeetus</u> <u>leucocephalus</u>	A regular winter visitor to the . Hanford reach of the Columbia River.			
Ferruginous hawk <u>Buteo regalis</u>	An occasional forager in sagebrush/grassland habitats on the Hanford Site.			
Thompson's sandwort <u>Arenaria franklinii thompsonii</u>	Exists as A. franklinii on stabilized sand dunes on the Hanford Site; taxonomic status of the Hanford form is under evaluation.			
Proposed Threatened Species				
Hoover's desert parsley Lomativum tuberosum	A regional endemic plant.			
Columbia milk-vetch <u>Astragalus</u> <u>columbianus</u>	A regional endemic plant.			

* Includes both federal and state designations.

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Table 2-5 includes endangered and threatened fauna which could frequent the areas near 300-FF-1. These include the endangered American white pelican and peregrine falcon, and the threatened Townsend's big-eared bat, bald eagle, and ferruginous hawk. The proposed endangered Columbia River tiger beetle may also inhabit the riparian zone of this area.

2.2.6.3 Sensitive Environments and Critical Habitats. Because there are no 0.02 km² (5 ac) wetlands near 300-FF-1 (EPA, 1987b), no sensitive environments exist. The Columbia River, however, could be regarded as an important environment with respect to this operable unit. The river's importance as a source of drinking and irrigation water in the region, as well as being a productive habitat for waterfowl, economically important fish species, and transitory endangered white pelicans and threatened bald eagles, could merit special concern for this environment during implementation of the remedial response. The Hanford reach is also the only stretch of the Columbia River within the United States that is not impounded by a dam (PNL, 1988). The Hanford reach has also been designated a Class A (excellent) surface water by the State of Washington (WAC 173-201-080(20)). This designation requires that water quality be maintained for domestic, industrial, and agricultural water supply, stock watering, fish and shellfish migration, rearing, spawning, harvesting, wildlife habitat, recreation (including primary contract), and commerce and navigation uses (WAC 173-201-045(2)(b)).

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Information as to whether the proposed-endangered Columbia River tiger beetle and the persistent sepal yellowcress actually reside on the banks of the river, along and immediately downstream of the operable unit, is lacking. If one of these species does exist here, the shoreline along 300-FF-1 would be regarded as a critical habitat for that species.

2.2.6.4 Land Use. For reasons of national security, as well as to ensure public health and safety, access to the entire Hanford Site is administratively controlled and is expected to remain controlled for the foreseeable future. Access to most of the 300 Area is restricted even further (DOE, 1987).

Land use in the area surrounding the Hanford Site consists primarily of irrigated and dry-land farming, livestock grazing, and urban and industrial development. Principal agricultural crops include hay, hops, wheat, potatoes, corn, other vegetables, apples, grapes, and other fruits. Most industrial activities in the area are associated with agriculture and energy production (DOE, 1987).

- 2.2.6.5 Water Use. Water use at and near Operable Unit 300-FF-1 can be discussed in terms of surface water and groundwater uses.
- 2.2.6.5.1 Surface Water. The Hanford reach of the Columbia River is used for multiple purposes: drinking water, industrial process water, irrigation, fishing, hunting, boating, and swimming (DOE, 1987; EPA, 1987b). Downstream intakes from the river within 6 km (4 mi) of the operable unit include the 300 Area process and drinking water intake, the Battelle Farm Operations irrigation water intake, the Tri-Cities University Center irrigation water intake, and the City of Richland drinking water intake. Up to 68,000 people could be supplied with drinking water from Richland's Columbia River source (EPA, 1987b). Additional details on the uses of the Columbia River near the 300 Area will be provided in the 300-FF-5 Work Plan.

2.2.6.5.2 Groundwater. Groundwater in the immediate vicinity of the 300 Area is utilized by the Life Science Laboratory, located about 340 m (1,100 ft) south of the 300-FF-1 Operable Unit boundary. The life science research activities entail the continuous use of one well to supply the fisheries laboratory, and the use of a well south of the facility to provide irrigation water during the growing season. In addition, an old reactor building in the 300 Area has a well that is sometimes used for fire protection.

There are several wells used for drinking or irrigation water within 6 km (4 mi) of the 300-FF-1 Operable Unit. Fifteen such private wells are located on the east side of the Columbia River, across from the 300 Area; the Hanford Patrol Training Academy has a drinking water well 3.1 km (1.9 mi) to the southwest; Battelle Farm Operations has an irrigation well 3.2 km (2 mi) south of the operable unit; and the City of Richland operates a recharge system 6 km (4 mi) south of 300-FF-1 which is comprised of 14 wells. Richland's recharge system supplements the river supply system and operates by pumping Columbia River water into unlined holding ponds, having the water infiltrate to the aquifer, then pumping the aquifer during periods of peak water demand (EPA, 1987b; Stenner et al., 1988).

2.2.7 Human Resources

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The demography, historical resources, and archeological resources of the 300 Area vicinity are discussed below.

- 2.2.7.1 Demography. Based on 1980 census data, 53,000 people live within 16 km (10 mi) of the 300 Area (PNL, 1987). There is only one residence within a 1.6 km (1 mi) radius of the 300-FF-1 Operable Unit, approximately 1.4 km (0.9 mi) east across the Columbia River. The City of Richland corporate boundary is about 1.9 km (1.2 mi) to the south, and the nearest residences are about 4.8 km (3 mi) from the operable unit (Stenner et al., 1988). In 1980, Richland had a population of 34,000 (DOE, 1987). The working population in the 300 Area is approximately 3,000 (Stenner et al., 1988).
- 2.2.7.2 Historical Resources. No designated historical sites are known to exist in the vicinity of the 300 Area.
- 2.2.7.3 Archeological Resources. Archeological resources are known to be present in the vicinity of the 300 Area. Artifacts have been found on the land surface, and significant archeological sites could be buried beneath the ground surface.

3.0 INITIAL EVALUATION

3.1 KNOWN AND SUSPECTED CONTAMINATION

3.1.1 Sources

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- 3.1.1.1 Types and Quantities. Estimated, non-radiological, chemical waste inventories are available for the south process pond, the north process pond, the 307 trenches, and the process trenches (DOE, 1985; Stenner et al., 1988), and are presented in Tables 3-1, 3-2, 3-3 and 3-4, respectively. No radionuclide inventories are available for any of these facilities.
- 3.1.1.2 Waste Characteristics. With the large number and wide variety of waste types known to have been disposed in the operable unit, it becomes necessary to focus on those which are of primary importance from the standpoint of posing a potential threat to human health or the environment. Table 3-5 presents all the known waste constituents which were disposed in greater than kilogram quantities at 300-FF-1. Those constituents which are designated as hazardous substances pursuant to CERCLA are so indicated.

Table 3-6 indicates which of the 300-FF-1 hazardous substances are known or suspected to have exceeded the reportable quantities promulgated under CERCLA. The waste inventories presented in Chapter 3.1.1.1, the documented unplanned releases in Appendix A, and the knowledge of facility operations as recorded in Chapter 2.1.4 were consulted in the preparation of Table 3-6.

Reportable quantities have no direct regulatory significance in this situation; however, the comparison of waste inventory values to reportable quantities is used as a gross toxicity screening. This analysis indicates that concern should be focused on the following waste constituents at the 300-FF-1 operable unit:

- e chromium.
- copper.
- hydrofluoric acid.
- lead,
- nickel,
- nitric acid,
- sodium hydroxide,
- sodium nitrite,
- tetrachloroethylene,
- uranium, and
- zinc.

These waste constituents can, in turn, be grouped by chemical characteristics.

Table 3-1. Estimated Non-Radiological Chemical Waste Inventory for the South Process Pond

Total Volume of Liquids Disposed:	10,000,000 m ³
<u>Chemical</u>	Quantity (kg)
beryllium	40
cadmium	80
chromium	5,000
copper	60,000
fluoride	7,000
lead	4,000
mercury	60
nickel	10,000
nitrate	1,000,000
nitrite	900,000
nitric acid	1,000,000
silver	1,000
sodium	2,000,000
sodium aluminate	2,000,000
sodium hydroxide	1,000,000
sodium silicate	100,000
trichloroethylene	100,000
uranium	40,000
zinc	5,000

Stenner et al., 1988

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Table 3-2. Estimated Non-Radiological Chemical Waste Inventory for the North Process Pond

Total Volume of Liquids Disposed:	10,000,000 m ³
<u>Chemical</u>	Quantity (kg)
beryllium	30
cadmium	60
chromium	3,000
copper	50,000
fluoride	5,000
lead	2,000
mercury	40
nickel	8,000
nitrate	800,000
nitrite	700,000
nitric acid	900,000
silver	900
sodium	1,000,000
sodium aluminate ·	2,000,000
sodium hydroxide	800,000
sodium silicate	90,000
trichloroethylene	100,000
uranium	30,000
zinc	3,000

Stenner et al., 1988

Table 3-3. Estimated Non-Radiological Chemical Waste Inventory for the 307 Trenches

Total Volume of Liquids Disposed:	1,000,000 m ³
<u>Chemical</u>	Quantity (kg)
beryllium	10
cadmium	20
chromium	1,000
copper	20,000
fluoride	2,000
lead .	600
mercury	10
nickel	3,000
silver	300
uranium	10,000
zinc	1,000

Stenner et al., 1988

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Table 3-4. Estimated Non-Radiological Chemical Waste Inventory for the Process Trenches (Prior to Implementation of Administrative Controls on February 1, 1985)

<u>Intermitten</u>	<u>t Discharges</u>	<u>Later Discharges</u> *		
<u><g< u=""></g<></u>	<u><kg< u=""></kg<></u>			
ammonium bifluoride antimony arsenic barium cadmium dioxane dioxin hydrocyanic acid pyridine selenium and compounds thiourea ton/yr** misc. laboratory chemicals	benzene carbon tetrachloride chromium chlorinated benzenes degreasing solvents formaldehyde formic acid hexachlorophene kerosene lead methyl ethyl ketone Mercury naphthalene nickel phenol silver sulfuric acid tetrachloroethylene toluene tributylphosphate (paraffin hydrocarbor 1,1,1-trichloroethane trichloroethylene xylenes	nitric acid <pre>acid</pre> <pre>sodium</pre> <pre>hydroxide</pre> <pre>canium</pre> <pre>canium</pre> <pre>canium</pre> <pre>canium</pre> <pre>canium</pre> <pre>canium</pre> <pre>canium</pre>	<pre>≤2000 kg/mo** mo ≤100 l/mo ne ~450 l***</pre>	

Included only because of the potential for dioxin to exist as a trace impurity in chlorinated benzenes.

- * These discharges, except for the spills, were relatively continuous.
- ** These materials are still discharged.

*** Known spills

DOE, 1985

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Table 3-5. Known Waste Constituents Disposed in Greater Than Kilogram Quantities(a)
In Operable Unit 300-FF-1
(Sheet 1 of 3)

<u>Waste Constituent</u>	<u>Listed Hazardous Substance</u> (b)
<u>Chemical</u>	
aluminum	
beryllium	X
cadmium	. X
chromic acid	X
chromium	X
chromium trioxide	Х
copper	X
copper sulfate	Х
detergents	
ethylene glycol	
fluoride	
heating oil	
hydrofluoric acid	Х
lead	Х
mercury	Х
nickel	Х
nitrate	
nitrite	•
nitric acid	X
oxalic acid	

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Table 3-5. Known Waste Constituents Disposed in Greater Than Kilogram Quantities(a)
In Operable Unit 300-FF-1
(Sheet 2 of 3)

<u>Waste Constituent</u>	<u>Listed Hazardous Substance</u> (b)
paint solvents	χ(c)
phosphoric acid	X .
potassium nitrite	
silicon	
silver	X
sodium	
sodium aluminate	
sodium carbonate	
sodium dichromate	X
sodium fluorosilicate	•
sodium gluconate	
sodium hydroxide	X
sodium nitrate	
sodium nitrite	X
sodium pyrophosphate	
sodium silicate	
tetrachloroethylene	X
trichloroethylene	X
zinc	χ .
zirconium	

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Table 3-5. Known Waste Constituents Disposed in Greater Than Kilogram Quantities(a)
In Operable Unit 300-FF-1
(Sheet 3 of 3)

<u>Waste Constituent</u>	<u>Listed Hazardous Substance(b)</u>
<u>Radiological</u>	
cesium-137	X
chromium-51	X .
cobalt-58	X
cobalt-60	Х
iron-59	X
plutonium isotopes	Х
scandium-46	χ
thorium-234	X
uranium isotopes	X
zinc-65	X
zirconium/niobium isotopes	X .
(a)Except for radionuclides.	
(b)40 CFR Part 302.4.	
(c)Common components of paint solvents, isobutyl ketone, toluene, and xylene	e.g., methyl ethyl ketone, methyl

Table 3-6. Hazardous Substances Disposed In Greater Than Kilogram Quantities (a) In Operable Unit 300-FF-1 (Sheet 1 of 2)

	<u> Hazardous Substance</u>	<u>RQ_(1b/d)</u> (b)	Known or Suspected to Have (c) <u>Exceeded RQ</u>
	<u>Chemical</u>		
	beryllium and compounds	1(d)	
	cadmium and compounds	1(d)	
	chromium and compounds	1(d)	Х
0	copper and compounds	1(d)	Х
LO	hydrofluoric acid	100	Х
('&'	lead and compounds	1(d)	X
GRAPHET	mercury and compounds	_I (d)	
<u>, m</u>	methyl ethyl ketone	5,000	
·ģ.	methyl isobutyl ketone	5,000	
	nickel and compounds	1(q)	Х
30710779	nitric acid	1,000	
\bigcirc	phosphoric acid	5,000	
il and	silver and compounds	1(d)	
	sodium hydroxide	1,000	X
	sodium nitrite	100	X
	tetrachloroethylene	1	X
	toluene	1,000	
	trichloroethylene	1,000	
•	xylenes	1,000	
•	zinc and compounds	1(d)	. X

Table 3-6. Hazardous Substances Disposed In Greater Than Kilogram Quantities (a) In Operable Unit 300-FF-1 (Sheet 2 of 2)

<u>Hazardous Substance</u>	<u>RQ (1b/d)</u> (b)	Known or Suspected to Have (c) Exceeded RQ
Radiological	10707	EXCeeded_RQ
chromium-51	_l (e)	
cobalt-58	1(e)	
cobalt-60	1(e)	
iron-59	1(e)	
plutonium isotopes	_I (e)	
promethium-147	1(e)	
scandium-46	1(e)	
thorium-234	1(e)	
uranium isotopes	l(e)	Х
zinc-65	1(e)	
zirconium/Niobium isotopes	1(e)	

⁽a) Except for radionuclides.

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⁽b) Reportable quantity per 40 CFR Part 302.4.

⁽c)Based on waste volume inventories presented in Section 3.1.2 and unplanned release documentation in Appendix A.

⁽d) Reportable quantities have not been assigned by regulation to generic classes of hazardous substances; however, the statutory RQ for these generic classes is 1 lb/d (40 CFR Part 302.4).

⁽e)Reportable quantity for all radionuclides is 1 lb/d (40 CFR Part 302.4).

3.1.1.2.1 Metals. Chromium, copper, lead, nickel, uranium, and zinc all persist in the environment, as they are not subject to biodegradation or chemical decomposition. Metal mobility within the environment is highly dependent on the exact chemical form of the element, which in turn is dependent on environmental conditions. Because many metals bind ionically to soils or form insoluble precipitates, their environmental mobility is generally somewhat retarded.

Chromium, copper, lead, nickel, and zinc are known to display a tendency for bioaccumulation. Their bioconcentration factors for fish tissue range from 16 for chromium to 200 for copper (EPA, 1986b).

- 3.1.1.2.2 Corrosives. Corrosive wastes of interest in the 300-FF-1 operable unit are hydrofluoric acid, nitric acid, sodium hydroxide, and sodium nitrite. These compounds would not persist in the environment because they rapidly dissociate into their constituent ions once in contact with water. As a result, they are relatively mobile and have the ability to affect the pH of the environment.
- 3.1.1.2.3 Volatile Halogenated Aliphatic Hydrocarbons. Tetrachloroethylene is a chlorinated, volatile organic compound which is heavier than, and only slightly soluble in, water. Because of its volatile nature, however, it can be very mobile. It has a bioconcentration factor for fish tissue of 31 (EPA, 1986b).

With a half life that ranges from 1 to 30 days in water (EPA, 1986b), tetrachloroethylene decomposes in the biologically active environment. Tetrachloroethylene is therefore less persistent than metals, for example. Degradation products from this process include other chlorinated compounds such as trichloroethylene, trans-1,2-dichloroethylene, and vinyl chloride.

3.1.1.2.4 Radionuclides. Besides being a metal, uranium is radioactive. It is a high energy alpha emitter with the major isotopes having half lives on the order of one billion years. Natural uranium consists of approximately 99.3% uranium-238, 0.7% uranium-235, and a very small portion of miscellaneous isotopes.

3.1.2 Soil

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3.1.2.1 Background Soil Quality. Preliminary background soil quality information is available from five soil samples obtained from a vertical boring (S-7) near the south process pond (Dennison et al., 1988). Representative background concentrations determined from these samples are listed in Table 3-7. In addition to being restricted to a single location, the available background soil analyses are limited both in number and in analytical parameters. Additional background values reported for the process trenches were not included due to uncertainties in quality of the historical data used for this purpose.

Table 3-7. Summary of Background Soil Quality Data for Operable Unit 300-FF-1

PARAMETERS DETECTED	UNITS	DETECTION LIMIT	GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION	UPPER 95% CONFIDENCE LIMIT FOR THE 0.95 QUANITLE	UPPER 95% CONFIDENCE LIMIT FOR THE 0.99 QUANTILE	DETECTIONS, ANALYSES
gross alpha	pCi/g	6	4.62	1.81	56.2	140	2/5
gross beta	pCi/g	3	21.3	1.14	37.0	45.2	5/5
a luminum	mg/kg	15	9,690	1.27	26,500	38,300	5/5
arsenic	mg/kg	0.5	2.66	1.87	37.1	97.2	5/5
barium	mg/kg	0.6	93.0	1.36	339	545	5/5
beryllium	mg/kg	0.5	0.37	1.69	3.4	7.6	2/5
cadmium	mg/kg	0.2	0.24	2.57	12.8	54.6	3/5
calcium	πg/kg	5	7,010	1.64	56,300	120,000	5/5
chromium	mg/kg	1	9.73	1.15	17.5	21.7	5/5
copper	mg/kg	1	17.6	1.42	77.0	132	5/5
iron	mg/kg	5	27.300	1.18	54,800	70,700	5/5
lead	mg/kg	0.5	4.99	1.24	12.3	17.2	5/5
magnesium	mg/kg	5	6.090	1.23	14,600	20,000	5/5
manganese	mg/kg	0.5	391	1.19	813	1.060	5/5
nickel	mg/kg	1	7.53	1.17	14.6	18.6	5/5
potassium	mg/kg	10	1,590	1.24	3,930	5,480	5/5
sodium	mg/kg	10	287	1.66	2,420	5,290	5/5
strontium	mg/kg	30	23.2	1.49	124	230	3/5
vanadium	mg/kg	0.5	59.6	1.13	99.7	120	5/5
zinc	mg/kg	0.5	49.5	1.21	110	148	5/5
chloride	mg/kg	1	1.08	2.07	23.1	70.8	3/5
fluroide	mg/kg	1	0.91	2.39	35.7	136	2/5
nitrate .	mg/kg	1	0.58	1.40	2.4	4.0	1/5
sulfate	mg/kg	1	6.61	4.24	2,890	26,700	4/5
cesium-137	pCi/g	0.5-0.6	0.08	3.40	13.8	90.9	3/3
uranium-235	pCi/g	0.3-0.5	1.1	23.0	595,000	74,100,000	2/3
uranium-238	pCi/g	7	2.5	1.55	15.8	31.1	1/3

Dennison et al., 1988, (samples from borehole S-7).

In order to allow for preliminary comparisons with measured soil concentrations and identify parameters which significantly exceed the distributions of background concentrations, a statistical description of the background data was conducted. This description assumed the background data to be lognormally distributed. A lognormal distribution is the most commonly employed probability density model for the assessment of environmental contaminants (Gilbert, 1987). The upper 95% confidence limits for the 0.95 and 0.99 quantiles of background concentrations for each detected parameter were calculated. If any analysis resulted in a value less than the reported detection limit, a value of one half the detection limit was substituted for the statistical calculations.

3.1.2.2 Soil Contamination.

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3.1.2.2.1 South and North Process Ponds. North process pond soil samples were obtained from one location in 1970, at depths of up to 1.2 m (4 ft) below the bottom of the pond. Fifteen additional surface soil samples were obtained from the south process pond, at increasing distances from the pond inlet, in 1974.

A recent sampling program resulted in an extensive characterization of the south and north process pond soils. Soil samples were obtained from 14 excavations in and adjacent to the ponds. In each pond, six sampling locations were excavated with a bulldozer to a depth of approximately 4.6 m (15 ft). One additional sampling location was excavated to the same depth, adjacent to each pond. The location adjacent to the north pond was chosen to collect samples in a natural depression used to dispose of some of the soils dredged from the pond.

The sampling locations within each pond were chosen to assess changes in contamination between successive settling ponds with increasing distance from each pond inlet. An average of five samples were taken from each excavation, beginning at the pond surface down to a maximum depth of between 2.9 and 5.03 m (9.4 and 16.5 ft). Sample depths varied between holes in order to obtain samples from distinctive (disturbed or greenish color) horizons. Higher readings were noted for radiological scans of the greenish colored soils. Samples from less distinctive horizons were also collected. Many of the soils were covered or mixed with flyash.

Each of the analytical parameters detected in the pond soils during any of the three investigations described above is presented in Table 3-8. The table also indicates the maximum concentration encountered for each parameter, and whether or not this value exceeds the upper 95% confidence limits for the 0.95 and 0.99 quantiles for the corresponding background distributions. Any parameter found in excess of the upper 95% confidence limit for the 0.99 quantile can be regarded as a contaminant with a high degree of certainty.

Nearly all of the detected metals were found in concentrations highly elevated above background, where background soil concentrations are available for comparison. Two metals, antimony and thallium, were detected only once. Elevated gross alpha and gross beta indicate that radionuclides are present. Analyses for specific radionuclides indicated the presence of both uranium and cobalt-60 in highly elevated concentrations.

Table 3-8. Summary of Soil Quality Data For the South and North Process Ponds (Sheet 1 of 2)

	PARAMETERS DETECTED	UNITS	DETECTION LIMIT	MAXIMUM VALUE DETECTED	DETECTIONS/ ANALYSES
			_		
	gross alpha**	pCi/g	6	1,960	44/70
	gross beta**	pCi/g	3	2,140	70/70
	aluminum**	mg/kg	15	81,800	70/70
	antimony**	mg/kg	10	20.0	1/70
	arsenic**	mg/kg	0.5	148	70/70
	barium**	mg/kg	0.6	994	70/70
	berillium	mg/kg	0.5	7.0	69/85
	cadmium*	mg/kg	0.2	13.0	76/85
	calcium	mg/kg	5	55,100	70/70
LO	chromium**	mg/kg	1	30,000	92/92
Boot 6	copper**	mg/kg	1	87,000	95/95
ហ	iron	mg/kg	5	44,400	74/74
	lead**	mg/kg	0.5	390	85/85
C.	magnesium	mg/kg	5	12,100	70/70
Revenue.	manganese	mg/kg	0.5	746	70/70
	mercury**	mg/kg	0.1	16.0	45/85
, a	nickel**	mg/kg	1	3,100	85/85
	potassium	mg/kg	10	2,320	70/70
Trans	selenium**	mg/kg	0.5	8.25	4/70
•	silver**	mg/kg	1	349	34/85
3-00	sodium* strontium**	mg/kg	10	2,940	70/70
******	thallium**	mg/kg	30 0 F	410	32/70
	uranium#	mg/kg mg/kg	0.5 100	2.8	1/70
de rroy	vanadium*	mg/kg	0.5	23,000 107	22/25
0	zinc**	mg/kg	0.5	770	70/70
and a	zirconium#	mg/kg	<25,000	36,000	85/85 6/6
Tur- 4		g/ 10g	125,000	30,000	6/6
	chloride**	mg/kg	1	405	23/73
	fluoride**	mg/kg	ī	200,000	65/88
	nitrate**	mg/kg	ī	8,000	64/73
	phosphate**	mg/kg	2	8.3	3/70
	sulfate*	mg/kg	2 1	4,400	70/73
	arochlor 1248**	mg/kg	0.1	42.0	20/70
	arochlor 1254**	mg/kg	0.1	0.44	3/70
	butylbenzylphthalate**	mg/kg	1	1.8	2/70
	diethylphtlalate**	mg/kg	i	2.1	1/70
	bis(2-ethylhexyl)phthalate**	mg/kg	ī	1.1	1/70
	methylene chloride**	mg/kg	0.01	0.089	8/70
	trichloroethylene**	mg/kg	0.01	0.050	1/70
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Table 3-8. Summary of Soil Quality Data For the South and North Process Ponds (Sheet 2 of 2)

PARAMETERS DETECTED	<u>UNITS</u>	DETECTION LIMIT	MAXIMUM VALUE DETECTED	DETECTIONS/ ANALYSES
cesium-137	pCi/g	~0.5	1.72	22/27
cobalt-60**	pCi/g	~0.2	87.7	13/27
uranium-235	pCi/g	~0.3	114	20/27
uranium-238**	pCi/g	~7	1,270	24/27

[#] No background data available

Dennison et al., 1988

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^{*} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile

^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.99 background quantile.

All of the anions detected were elevated to some extent. Organic compounds were generally detected less frequently. Polychlorinated biphenyls (PCBs), specifically Arochlors 1248 and 1254, and methylene chloride were the only organic compounds detected in more than two samples.

In general, contaminant concentrations decreased with increasing distance from the pond inlets and with depth. For the most part, the depth of contaminant penetration was limited to within 0.9 to 1.2 m (3 to 4 ft) of the pond surfaces. The maximum depth of contamination, in excess of background levels, was encountered at 5.03 m (16.5 ft) near the north pond inlet.

3.1.2.2.2 307 Trenches. Limited information on soil contamination is available for the 307 trenches. The bulk of the contaminated soils were removed from the operable unit when the trenches were retired in 1963. Contaminated soils from the south process pond were subsequently disposed of in the 307 trenches and covered with flyash from the 300 Area ash pits. The area is currently backfilled with clean soil.

A portion of the 307 trenches was recently excavated, thereby exposing visibly contaminated soils. Five samples of these soils were analyzed, and a summary of the results for the detected parameters is presented in Table 3-9.

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Total concentrations of several metals including aluminum, beryllium, chromium, copper, mercury, nickel, and silver were significantly elevated above background. Gross alpha and beta levels were also significantly elevated, indicating the presence of uranium and other radionuclides. Nitrate was the only anion detected at highly elevated concentrations, and the only organic compound detected was Arochlor 1248. All of these contaminants are also associated with the process pond sediments from which they were derived.

3.1.2.2.3 Process Trenches. A large number of soil samples from the process trenches has been analyzed for potential contaminants. The earliest sampling consisted of six composited samples obtained from the west trench, as documented in an internal WHC memo dated August, 1985. These samples were composited from three depths from the trench bottom: 0, 0.3, and 0.6 m (0, 1, and 2 ft). These samples were analyzed for a complete range of metals, including many for which background characteristics are unknown.

A more extensive sampling program was implemented in 1986. Soil samples were obtained at 30 m (100 ft) intervals along the bottom of each trench at three depths: 0, 0.09, and 0.46 m (0, 0.3, and 1.5 ft). All of these samples were analyzed for screening parameters (metals, gross alpha and beta, total organic halogen, and total organic carbon), seventeen samples were subjected to a more complete analytical characterization, and six surface samples were tested for extraction procedure toxicity.

Six exploratory borings were also drilled on 90 m (300 ft) centers along the berm separating the process trenches during the 1986 investigation. Soil samples were taken from bailed cuttings at depth intervals of 1.5 m (5 ft) to a maximum depth of 12 to 14 m (40 to 45 ft). The 45 samples thus obtained were analyzed for the screening parameters, and nine of the samples were subjected to the more complete characterization.

Table 3-9. Summary of Soil Quality Data for the 307 Process Trenches

PARAMETERS DETECTED	<u>UNITS</u>	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
gross alpha** gross beta**	pCi/g pCi/g	6 3	234 378	4/5 5/5
aluminum* barium beryllium** cadmium calcium chromium** copper** iron magnesium manganese mercury** nickel** potassium silver** sodium strontium vanadium zinc	mg/kg	15 0.6 0.5 0.2 5 1 1 5 0.5 0.1 1 10 30 0.5 0.5	26,700 133 8 1 33,200 259 2,850 33,500 11,600 396 2.77 221 1,830 18.0 401 67.0 73.0 97.0	5/5 5/5 5/5 5/5 5/5 5/5 5/5 5/5 5/5 5/5
chloride fluoride nitrate** sulfate	mg/kg mg/kg mg/kg mg/kg	1 1 1	1.1 2.0 30.4 52.0	1/5 4/5 5/5 5/5
arochlor 1248**	mg/kg	0.1	9.90	5/5

^{*} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile.

Appendix B

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^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.99 background quantile.

A list of all analytical parameters which have ever been detected in the process trenches soils is presented in Table 3-10. Several metals, including antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc, were all detected at levels which are highly elevated above background. Other metals (e.g., uranium) probably also exist at highly elevated concentrations; however, background distributions for several such metals have not been established.

Extraction procedure toxicity results are shown in Table 3-11. These data suggest that many of the metals contained in the sediments are not highly mobile. They also indicate that the surface soils do not exceed criteria for dangerous waste designation.

Gross beta and lo alpha are highly elevated, thus indicating the presence of radionuclides. Based on the estimated volumes of waste constituents discharged to the process trenches (Table 3-4), uranium is known to be the dominant radionuclide present.

Of the detected nonmetallic ions, only nitrate and chloride were found in highly elevated amounts. Background concentrations have not been established for three of the detected nonmetallic ions: ammonium, cyanide, and sulfide.

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Several organic compounds were identified within the soils; however, only two compounds--methylene chloride and tetrachloroethylene--were detected in more than one sample. Tetrachloroethylene is the only detected organic compound known to have been disposed in the trenches in greater than kilogram (pound) quantities.

A summary of the parameters detected in the deep borings is presented in Table 3-12. Beryllium and mercury are the only compounds identified at concentrations which are highly elevated above background conditions. Mercury, however, was detected in fewer than 5% of the deeper soil samples.

It is possible that the deeper soil samples are not representative of the actual vertical extent of soil contamination. These samples were obtained along a line offset from the trench bottoms by approximately 4.6 m (15 ft). Given the coarse grained nature of the soils underlying the trenches, little lateral dispersion of contaminants by capillary diffusion would be expected. Therefore, the maximum contamination within the deeper soils is expected to lie directly beneath the trenches. The results from the deep, offset borings do, however, indicate quite strongly the lateral extent of contamination is limited within the soil column.

3.1.2.2.4 Burial Grounds. Three burial grounds are located within the 300-FF-1 Operable Unit: #4, #5, and the north process pond scraping disposal area. Burial grounds #4 and #5 are known only to contain materials which are contaminated with uranium (Stenner et al., 1988); no sampling has been reported for these two facilities.

The north process pond scraping disposal area was used to dispose of dredged soils from the north process pond as well as flyash (Stenner et al., 1988). Soil contamination within this disposal area is known to be similar to that described previously for the north process pond, because samples have been taken in this area in conjunction with the north pond soil investigation discussed previously.

Table 3-10. Summary of Soil Quality Data for the Process Trenches (Sheet 1 of 2)

PARAMETERS DETECTED	<u>UNITS</u>	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
lo alpha#** gross beta**	pCi/g pCi/g	NR NR	1,870 27,600	113/113 108/113
aluminum antimony** arsenic** barium* beryllium* bismuth# boron# cadmium** calcium cerium# chromium** cobalt# copper** iron lanthanum# lead** magnesium manganese** mercury** molybdenum# nickel** phosphorus# potassium selenium** silicon# silver** sodium strontium* ttin# titanium# tungsten# uranium#	mg/kggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkggmg/kkgggmg/kkgggmg/kkgggmg/kkgggmg/kkgggmg/kkgggggg/kggg/kggggg/kgggg/kggggg/kgggggg	15 10 0.5 0.6 0.5 <28.9 <43.8 0.2 5 <1,320 1 <16.7 1 5 <79.8	19,500 140 221 485 6.0 37.2 100 6,440 17,600 2,270 551 19.8 8,470 36,400 182 486 5,800 6,740 825 34.0 4,700 3,080 2,060 135 385 245 1,440 175 7,460 375 2,370 96.9 4,210	119/119 90/119 29/32 119/119 6/6 6/6 6/6 114/119 118/119 6/6 119/119 119/119 6/6 119/119 118/119 72/119 6/6 117/119 6/6 117/119 6/6 117/119 6/6 117/119 6/6 117/119 6/6 6/6 6/6 6/6 6/6 6/6
vanadium** Zinc** zirconium#	mg/kg mg/kg mg/kg	0.5 0.5 <128	207 895 425	108/115 115/119 6/6
ammonium# chloride* cyanide# fluoride nitrate**	mg/kg mg/kg mg/kg mg/kg mg/kg	0.5 1 1 1	570 25.2 1.3 33.1 467	13/26 18/31 2/26 15/26 14/26

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Table 3-10. Summary of Soil Quality Data for the Process Trenches (Sheet 2 of 2)

PARAMETERS DETECTED	<u>UNITS</u>	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
sulfate	mg/kg	1	66.3	23/26
sulfide#	mg/kg	1	500	5/26
benzo[a]pyrene**	mg/kg	1	25.0	1/26
benzo[b]fluoranthene**	mg/kg	ī	14.0	1/26
butylbenzyphthalate**	mg/kg	$\bar{1}$	3.3	1/26
chrysene**	mg/kg	ī	12.0	1/26
trans-1,2-		-	12.0	1/ 40
Dichloroethylene**	mg/kg	0.01	0.04	1/26
methylene chloride**	mg/kg	0.01	0.04	2/26
tetrachloroethylene**	mg/kg	0.01	0.011	4/26
toluene**	mg/kg	0.01	0.02	1/26
meta-Xylene**	mg/kg	0.01	0.02	
			· · · · · · · · · · · · · · · · · · ·	1/26
ortho-and para-Xylene**	mg/kg	0.01	0.03	1/26
Radium#	pCi/g	NR	11.4	26/26

[#] No background data available

NR Not reported

DOE, 1985;

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^{*} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile.

^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.99 background quantile.

Table 3-11. Extraction Procedure Toxicity Results for Process Trenches Soils

	REGULATORY CRITERION mg/L	MEAN mg/L	UPPER 95% CONFIDENCE LIMI mg/L
arsenic	5.0 0.10	0.10	
barium	1,000 11.15	0.10	
cadmium	1.0 0.05	0.03	
chromium	5.0 0.04	0.02	
lead	5.0 0.34	0.24	
mercury	0.2 0.06	0.04	
selenium	1.0 0.13	0.13	
silver	5.0 0.02	0.02	

Note: one half the detection limit was substituted for results reported as being below the detection limit, the sample size was 6.

Table 3-12. Summary of Vadose Zone Soil Quality Data for the Process Trenches

PARAMETERS		DETECTION	MAXIMUM	NUMBER OF	NUMBER OF
DETECTED	<u>UNITS</u>	LIMIT	CONCENTRATION	DETECTIONS	NUMBER OF ANALYSES
aluminum	mg/kg	15	8,470	48	48
arsenic	mg/kg	0.5	7.13	9	9
barium	mg/kg	0.6	118	48	48
beryllium*	mg/kg	0.5	4	14	48
cadmium	mg/kg	0.2	9	48	48
calcium	mg/kg	5	8,560	48	48
chromium	mg/kg	1	10	48	48
copper	mg/kg	1 -	37	48 .	48
iron lead	mg/kg	5 0.5	2,740	48	48
	mg/kg	0.5	5.99	. 48	48
manganese mercury**	mg/kg	0.1	346 0.11	48 2	48
nickel	mg/kg mg/kg	1.0	8	48	48
notaccium	mg/kg	10		40 48	48
potassium Sodium	mg/kg	10	1,030 747	48	48 48
_strontium	mg/kg	30	31	1	9
vanadium	mg/kg	0.5	83	48	48
Zinc	mg/kg	0.5	50	48 48	48 48
21110	11197 Kg	0.5	30	40	40
ammonium#	mg/kg	0.5	15	6	a
chloride	mg/kg	1	10.6	. 6 . 7	q
fluoride	mg/kg	ī	2.02	· 7	9
_nitrate	mg/kg	1	1.56	7 2 3	9 9 9 9
sulfate	mg/kg	1	21.2	3	9

lo alpha#	pCi/g	NR	10.5	48	48
gross beta	pCi/g	NR	24.5	48	48
total radium#	pCi/g	NR	1.41	10	10
TOX#	mg/kg	1	7.2	28	48
TOC#	mg/kg	10	43.7	28 8	48 48
"	פיי /כייי		10.7	•	70
coliform	mpn	3.0	110	4	9

[#] No background data available

NR Not reported

^{*} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile

^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.99 background quantile

3.1.2.2.5 Retired Radioactive Sewer System. A leak from the retired radioactive sewer system was discovered in 1969. The leak occurred at a corroded pipe connection about 1.5 m (5 ft) below ground surface. Grossly contaminated soil above and immediately in the vicinity of the leak was excavated and removed. Based upon the radionuclides present, the leak was determined to have existed for a least two years.

The leak from the radioactive waste sewer system was investigated in two stages. As part of an emergency assessment, two holes were dug in the vicinity of the leak: the first to a depth of 2.7 m (9 ft) below the leak and the second to a depth of 3.4 m (11 ft) below ground surface, 3.0 m (10 ft) east of the leak. Samples from the first hole were analyzed for radionuclides. No radioactivity was detected within the second hole using a GM detector in the field.

Following the initial assessment of contamination, additional holes were drilled to between 4.6 and 6.1 m (15 and 20 ft) in depth along a single radial line oriented in a southeast direction from the leak. These holes were located at distances of 1.5, 2.0, 3.0, and 4.6 m (5, 6.5, 10, and 15 ft) from the leak. Samples were collected at 0.6 m (2 ft) intervals below a depth of 1.8 m (6 ft) and screened for radioactivity in the field.

Selected samples were sent to the laboratory for radionuclide analysis. The radionuclides detected and their maximum concentrations are summarized in Table 3-13. All of the detected radionuclides generally exhibited a significant decline in concentration below a depth of 4.6 to 6.1 m (15 to 20 ft). Promethium-147 was the principal radionuclide present, accounting for about 800 Ci of the estimated 900 Ci of total activity from all radionuclides detected. Over 90% of the total radionuclide contamination was estimated to exist above a depth of 7.6 m (25 ft) and within a radius of 3.7 m (12 ft) from the detected leak.

3.1.3 Groundwater

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The following is a preliminary evaluation of the known nature and extent of contamination in groundwaters beneath 300-FF-1. A more extensive evaluation of the existing data will be contained within the 300-FF-5, the 300 Area groundwater operable unit, work plan.

3.1.3.1 Background Groundwater Quality. Background characteristics for groundwater were based on measured concentrations within the 3-1-18 well cluster during the period January 1985 to June 1988. Additional wells may also be suitable for assessment of background conditions; however, these data were not available for this analysis. The 3-1-18 well cluster is located to the north of 300-FF-1 (Figure 3-1).

The 3-1-18 well cluster includes three wells completed at three different depths. These completion depths correspond to the three aquifer zones beneath the 300 Area identified by Schalla et al. (1988): shallow, intermediate, and deep.

Table 3-13. Summary of Radionuclide Data in Soils for Radioactive Sewer Leak

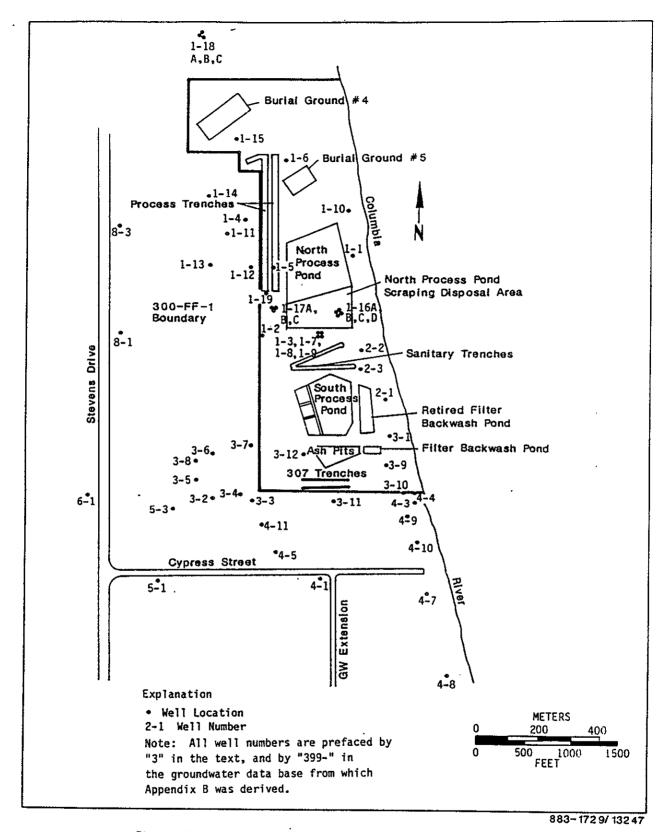
<u>PARAMETER</u>	MINIMUM DETECTION LIMIT(a)	MAXIMUM VALUE <u>DETECTED</u> (a)	NUMBER OF DETECTIONS	NUMBER OF ANALYSES
241Am 141Ce 144Ce 134Cs 137Cs 95Nb 147Pm 106Ru 103Ru 90Sr 95Zr	400 5 38 4 2 5 300 60 3 1×10 ⁴ 5	1.2x10 ⁵ 5.4x10 ³ 4.1x10 ⁶ 8.0x10 ⁴ 3.6x10 ⁶ 3.4x10 ⁷ 2.1x10 ⁶ 1.5x10 ⁴ 6.4x10 ⁵ 3.4x10 ⁴	11 10 16 7 10 11 16 13 4 14	21 12 18 10 15 13 23 15 10 23

⁽a) Concentrations in disintegrations/min/g

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Figure 3-1. Well Locations for 300-FF-1 Operable Unit

Shallow wells are completed within the upper unconfined aquifer, between a depth of about 12 to 24 m (40 to 80 ft) below land surface. This zone corresponds to the highly permeable sands and gravels of the Hanford formation and the upper portion of the middle member of the Ringold Formation.

Intermediate wells are completed within the relatively less permeable lower portion of the middle member of the Ringold Formation, between a depth of about 34 to 37 m (110 to 120 ft). This lower zone is part of the unconfined aquifer but is locally semiconfined by thin silt lenses within the middle member of the Ringold Formation.

Deep wells are completed within the basal member of the Ringold Formation, usually between a depth of about 52 to 55 m (170 to 180 ft). However, basalt was encountered in deep well 3-1-18C at a depth of only about 43 m (40 ft). The basal member is associated with the uppermost confined aquifer under the 300 Area.

Background water quality data for the shallow, intermediate, and deep zones are summarized in Tables 3-14, 3-15, and 3-16, respectively. The same statistical description employed for background soils, as described in Chapter 3.1.2.1, is also employed for background groundwater.

3.1.3.2 Groundwater Contamination. Numerous monitoring wells are located within and adjacent to the 300-FF-1 operable unit. The location of these wells is shown in Figure 3-1. A summary of the completion characteristics of these wells is presented in Table 3-17. The majority of the wells located within and near 300-FF-1 have been installed over the past three years under the RCRA groundwater investigation for the process trenches (Schalla et al., 1988). Data are available for all three of the principal aquifer zones identified in Chapter 3.1.3.1. Most of the wells, however, are completed within the shallow zone. Data for the intermediate and deep zones are available at four well clusters: 3-1-16A,B,C,D; 3-1-17A,B,C; 3-1-18A,B,C (preliminary background wells); and 3-1-3,7,8,9. Wells 3-4-5, 3-4-9, and 3-5-2 are also completed within the deep zone.

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Groundwater quality data were obtained from three sources: Schalla et al. (1988), Appendix B (derived from a Hanford Site groundwater data base), and PNL (1988). Schalla et al. have summarized contaminant distributions for a couple of parameters in the groundwater, based on the results of RCRA monitoring. Appendix B provides a complete range of measured groundwater parameters. That portion of the data base downloaded for the development of this document is limited to selected wells, and provided data from January 1985 to June 1988. A printout of these data is presented in Appendix B. The data available from PNL (1988) provide information for a greater number of wells.

Comparison of the water quality data obtained from Appendix B indicates that the maximum concentrations of some of the parameters identified in Tables 3-18, 3-19, and 3-20--for the shallow, intermediate, and deep groundwater zones respectively--are highly elevated above preliminary background levels. The intermediate and deep groundwater zones have a different water chemistry than the shallow zone, with the bulk of the contamination being restricted to the shallow zone (Schalla et al., 1988).

Table 3-14. Background Water Quality for Shallow Groundwater at Operable Unit 300-FF-1 (Sheet 1 of 2)

PARAMETERS D	DETECTED	UNITS	DETECTION LIMIT	GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION	UPPER 95% CONFIDENCE LIMIT FOR THE 0.95 QUANITLE	UPPER 95% CONFIDENCE LIMIT FOR THE 0.99 QUANTILE	DETECTIONS, ANALYSES
gross alpha		pCi/L	4	3.2	1.24	6.7	8.7	7/7
gross beta		pCi/L	8	11.5	1.40	36.1	54.8	7/7
рН		std. unit:	0.1	7.61*	0.16*	7.07, 8.15*	6.87, 8.35*	7/7
specific con	ductance	umho/cm	1	425	1.08	552	608	7/7
total organi	ic carbon	<i>μ</i> g/L	1,000	324	1.64	1,740	3,220	7/7
total organi	ic halogen	βg/L	20	5.8				1/1
arsenic	(total)	Д 9/L	5	3.3	1.60	16.3	29.3	2/7
	(filtered)	μ ₉ /ι	5	3.8	1.69	22.6	43.4	3/7
barium	(total)	<i>Щ</i> g/L	6	47.1	1.05	55.6	59.1	7/7
	(filtered)	μg/L	6	46.8	1.04	53.5	56.1	7/7
calcium	(total)	μg/L	50	42,900	1.08	55,700	61,300	7/7
	(filtered)	μg/L	50	42,600	1.07	53,600	58,300	7/7
carbon	(total)	μg/L	?	29,500				1/1
chromium	(total)	Дg/L	10	6	1.59	29	52	1/7
iron	(total)	<i>μ</i> g/L	50	64	2.21	949	2,540	5/7
	(filtered)	Дg/L	50	30	1.57	139	244	1/7
magnesium	(total)	<i>Щ</i> g/L	?	12,200	1.04	13,900	14,600	7/7
	(filtered)	μ _g /L	?	12,000	1.03	13,300	13,800	7/7
potassium	(total)	<i>Д</i> g/L	100	6,150	1.05	7,260	7,710	7/7
	(filtered)	μ _{g/L}	100	6,020	1.04	6,880	7,220	7/7
sodium	(total)	μg/L	100	23,100	1.03	25,500	26,500	7/7
	(filtered)	<i>Щ</i> 9/L	100	22,500	1.03	24,900	25,800	7/7
strontium	(total)	µg/L	300	230				1/1
	(filtered)	μ⁄g/L	300	220				1/1
uranium	(total)	μ⁄g/L	0.725	4.28				1/1
vanadium	(total)	<i>Щ</i> 9/L	5	12.3	1.16	20.4	24.5	7/7
	(filtered)	<i>Щ</i> g/L	5	11.6	1.18	20.4	25.0	7/7
zinc	(total)	<i>Щ</i> g/L	5	2.9	1.48	11.0	17.9	1/7

Table 3-14. Background Water Quality for Shallow Groundwater at Operable Unit 300-FF-1 (Sheet 2 of 2)

DOE-RL 88-31 DRAFT

PARAMETERS DETECTED	UNITS	DETECTION LIMIT	GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION	UPPER 95% CONFIDENCE LIMIT FOR THE 0.95 QUANITLE	UPPER 95% CONFIDENCE LIMIT FOR THE 0.99 QUANTILE	DETECTIONS, ANALYSES
ammon i um	<i>jl</i> g/L	50	29	1.42	96	148	1/7
chloride	<i>µ</i> g/L	500	19,400	1.13	29,400	34,200	7/7
fluoride	<i>J</i> Jg/L	500	350	1.83	2,730	5,790	2/7
nitrate	$\mu_{ m g/L}$	500	21,500	1.04	24,600	25,800	7/7
sulfate	<i>µ</i> g/L	500	48,400	1.03	53,500	55,500	7/7
methyl ethyl ketone	<i> l</i> lg/L	10	7	2.29	117	328	1/7
radium	pCi/L	1	0.08	2.05	. 0.92	2.24	7/7

^{*} The arithmetic mean and standard deviation are presented for pH. The lower 95% confidence limits for the .05 and 0.1 quantiles, respectively, are also given in addition to those indicated.

PNL, 1988b (well 3-1-18A)

Table 3-15. Background Water Quality for Intermediate Depth Groundwater at Operable Unit 300-FF-1 (Sheet 1 of 2)

								
PARAMETERS D	ETECTED	E Units	DETECTION LIMIT	GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION	UPPER 95% CONFIDENCE LIMIT FOR THE 0.95 QUANITLE	UPPER 95% CONFIDENCE LIMIT FOR THE 0.99 QUANTILE	DETECTIONS ANALYSES
gross beta		pCi/L	8	9.4	1.34	27.8	41.4	6/6
pH		std. units	0.1	7.62*	0.48*	5.84, 9.40*	5.19, 10.05*	6/6
specific con	ductance	umho/cm	1	356	1.09	503	551	6/6
total organi	c carbon	µg/L	1,000	325	1.27	789	1,090	6/6
total organi	c halogen	μ _g /L	20	0.6				1/1
barium	(total)	<i>Щ</i> g/L	6	40.5	1.10	57.7	65.6	6/6
	(filtered)	Дg/L	6	41.3	1.05	49.5	52.9	6/6
calcium	(total)	βg/L	50	11,800	1.06	14,600	15,900	6/6
	(filtered)	<i>Щ</i> g/L	50	11,800	1.09	16,200	18,300	6/6
carbon	(total)	βg/L	?	42,400				1/1
chromium	(total)	μg/L	10	16	2.04	226	592	5/6
	(filtered)	βg/L	10	6	1.61	35	67	1/6
iron	(total)	βg/L	50	243	1.31	662	954	6/6
	(filtered)	<i>Щ</i> g/L	50	161	1.08	214	238	6/6
magnesium	(total)	<i>Щ</i> 9/L	?	5,270	1.06	6,540	7,080	6/6
	(filtered)	βig/L	?	5,220	1.03	5,830	6,060	6/6
manganese	(total)	<i>Щ</i> 9/L	5	46.8	1.10	66.7	75.8	6/6
	(filtered)	<i>µ</i> g/L	5	44.4	1.07	57.1	62.5	6/6
nickel	(total)	<i>Щ</i> 9/L	10	7	1.67	47	94	2/6
potassium	(total)	<i>Щ</i> g/L	100	6,540	1.08	8,700	9,660	6/6
	(filtered)	<i>Щ</i> 9/L	100	6,530	1.03	7,290	7,580	6/6
sodium	(total)	βg/L	100	64,600	1.06	. 80,200	86,800	6/6
	(filtered)	Дg/L	100	63,900	1.02	68,800	70,600	6/6
strontium	(total)	μ ₉ /L	300	80				1/1
	(filtered)	μg/L	300	80				1/1
uranium	(total)	μ _g /L	0.725	0.043				1/1
zinc	(total)	μ _g /L	5	6.3	2.10	98.9	270	4/6
	(filtered)	Дg/L	5	3.9	1.99	50.1	127	2/6

Table 3-15. Background Water Quality for Intermediate Depth Groundwater at Operable Unit 300-FF-1 (Sheet 2 of 2)

				CEONETRIC	HDDED DEW	אוויים סבא	
		DETECTION	GEOMETRIC	GEOMETRIC STANDARD	UPPER 95% CONFIDENCE LIMIT FOR	UPPER 95% CONFIDENCE LIMIT FOR	DETECTIONS/
PARAMETERS DETECTED	UNITS -	LIMIT	MEAN	DEVIATION	THE 0.95 QUANITLE	THE 0.99 QUANTILE	ANALYSES
ammon ium	μg/L	50	82	1.81	741	1,660	5/6
chloride	<i>μ</i> g/L	500	11,600	1.12	17,700	20,600	6/6
fluoride	μ g/L	500	1,540	1.27	3,740	5,170	6/6
sulfate	µ g/L	500	300	1.52	1,420	2,500	1/6
methyl ethyl ketone	<i>μ</i> g/L	10	6	1.80	53	118	1/6
cesium-137	pCi/L	20	0.4	1.65	206,000	46,700,000	1/2
cobalt-60	pCi/L	22.5	1.1	2.84	#	#	1/2
radium	pCi/L	1	0.03	5.87	#	#	1/2
strontium-90	pCi/L	5	0.4	1.59	77,800	11,800,000	1/2
uranium	pCi/Ł	0.5	0.06	1.09	0.58	1.47	1/2

Value calculated is meaninglessly high

PNL, 1988b (well 3-1-18B).

^{*} The arithmetic mean and standard deviation are presented for pH. The lower 95 percent confidence limits for the 0.05 and 0.01 quantiles, respectively, are also given in addition to those indicated.

Table 3-16. Background Water Quality for Deep Groundwater at Operable Unit 300-FF-1 (Sheet 1 of 2)

PARAMETERS	DETECTED	UNITS	DETECTION LIMIT	GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION	UPPER CONFIDENCE THE 0.95		UPPER 95% CONFIDENCE LIMIT FOR THE 0.99 QUANTILE	DETECTIONS, ANALYSES
gross alpha		pCi/L	4	0.2	1.21	0.4		0.5	6/6
gross beta		pCi/L	8	8.2	1.14	13.3		15.9	6/6
рH		std. units	0.1	7.85*	0.39*	6.40	, 9.30*	5.87, 9.83*	6/6
specific co	nductance	umho/cm	1	361	1.12	550		641	6/6
total colif	orms	mpn/100ml	2.2	1.72	2.98	98.9		434	1/6
total organ	ic carbon	<i>Щ</i> 9/L 1	,000	359	1.43	1,350		2,200	6/6
total organ	ic halogen	<i>μ</i> g/L	20	6	•	•		1/1	
barium	(total)	<i>Щ</i> g/L	6	67.3	1.05	80.7		86.2	6/6
	(filtered)	μg/L	6	67.3	1.06	83.5		90.4	6/6
ca lo i um	(total)	μg/L	50	12,100	1.08	16,100	!	17,900	6/6
	(filtered)	μg/L	50	12,200	1.10	17,400		19,800	
carbon	(total)	<i>μ</i> g/L	?	40,800	-	-		=	1/1
chromium	(total)	<i>Щ</i> g/L	10	14	2.22	270		795	4/6
iron	(total)	μ 9/L	50	154	1.27	374		517	6/6
	(filtered)	<i>μ</i> g/L	50	89	1.18	164		206	6/6
magnesium	(total)	<i>Щ</i> 9/L	?	5,260	1.02	5,660		5,810	6/6
	(filtered)	<i>μ</i> g/L	?	5,210	1.03	5,810		6,050	6/6
manganese	(total)	<i>Џ</i> g/L	5	51.4	1.07	66.1		72.4	6/6
	(filtered)	μ _g /L	5	47.6	1.07	61.2		67.1	6/6
nickel	(total)	μ ₉ /L	10	7	1.57	37		69	2/6
potassium	(total)	μ _{g/L}	100	6,740	1.04	7,800		8,220	6/6
	(filtered)	<i>μ</i> g/L	100	6,490	1.03	7,240		7,540	6/6
sodium	(total)	μg/L	100	66,500	1.01	69,000	(69,900	6/6
	(filtered)	Дg/L	100	65,400	1.04	75,600		79,800	6/6

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Table 3-16. Background Water Quality for Deep Groundwater at Operable Unit 300-FF-1 (Sheet 2 of 2)

PARAMETERS	DETECTED	UNITS	DETECTION LIMIT	GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION	UPPER CONFIDENCE THE 0.95	LIMIT FOR CO	UPPER 95% NFIDENCE LIMIT FOR THE 0.99 QUANTILE	DETECTIONS/ ANALYSES
strontium	(total)	<i>ji</i> g/L	300	80	_	-		_	1/1
	(filtered)	<i>µ</i> g/L	300	80	-	-		-	1/1
uranium	(total)	μg/L	0.725	0.071	-	-		-	1/1
zinc	(total)	βg/L	5	6.0	2.25	122	3	65	4/6
	(filtered)	<i>µ</i> g/L	5	3.2	1.90	34.6		82.6	1/6
ammon i um		<i>µ</i> g/L	50	114	1.31	311	4	48	6/6
chloride		<i> l</i> g/L	500	11,700	1.12	17,800	20,8	00	6/6
fluoride		µg/L	500	1,670	1.23	3,600	4,7	70	6/6
sulfate		<i>µ</i> g/L	500	1.840	1.25	4,210	5,7	00	6/6
methyl ethy	l ketone	μg/L	10	6	1.80	53	1	18	1/6
hydrogen-3		pCi/L	500	2	9.36	#		•	2/2
radium		pCi/L	1	0.1	2.28	2.1		6.5	6/6
uranium		pCi/L	0.5	0.08	1.51	4,010	348,0	00	2/2

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* The arithmetic mean and standard deviation are presented for pH.

The lower 95 percent confidence limits for the 0.05 and 0.01 quantiles, respectively, are also given in addition to those indicated.

Value calculated is meaninglessly high.

PNL, 1988b (well 3-1-18C).

Table 3-17. Well Completion Summary (Sheet 1 of 3)

WELL Number	DATE INSTALLED	DRILLED DEPTH (ft)	COMPLETION INTERVAL (ft)	GROUNDWATER ZONE MONITORED	DEPTH TO WATER (ft)	COMPLETION TYPE
3-1-1*	11/48	77	20-75	S	42	Perforated Steel Casing
3-1-2*	4/50	101	25-75	\$ \$	45	Perforated Steel Casing
3-1-3*	4/50	102	25-70	S	37	Perforated Steel Casing
3-1-4*	5/50	101	23-70	S	42	Perforated Steel Casing
3-1-5*	2/75	45	23-45	S	35	Stainless Steel Wire Wrap Screen
3-1-6*	2/75	44	22-44	S S	33	Stainless Steel Wire Wrap Screen
3-1-7*	3/85	75	25-75		37	Stainless Steel Wire Wrap Screen
3-1-8*	8/85	108	85-105	I	-	Stainless Steel Wire Wrap Screen
3-1-9*	2/87	181	170-180	D	42.9	Stainless Steel Wire Wrap Screen
3-1-10*	12/86	45	24.5-39.5	\$	29	Stainless Steel Wire Wrap Screen
3-1-11*	11/86	47	27-47	S	37	Stainless Steel Wire Wrap Screen
3-1-12*	11/86	65 56	45-60	S	39.1	Stainless Steel Wire Wrap Screen
3-1-13*		56	38-53	\$ \$	43	Stainless Steel Wire Wrap Screen
3-1-14*	11/86	50	31-46		36.5	Stainless Steel Wire Wrap Screen
3-1-15*	11/86	48	29-44	S	33.3	Stainless Steel Wire Wrap Screen
3-1-16A*	12/86	48	32.5-47.5	S	37.3	Stainless Steel Wire Wrap Screen
3-1-16B*	2/87	118	105-115	I	37.9	Stainless Steel Wire Wrap Screen
3-1-16C*	1/87	178	167.5-177.5	D	39	Stainless Steel Wire Wrap Screen
3-1-16D*	1/87	180	106-116	I	40.5	Stainless Steel Wire Wrap Screen
3-1-17A*	11/86	41	25-40	S	31.9	Stainless Steel Wire Wrap Screen
3-1-17B*	12/86	115	100-110	I	32.9	Stainless Steel Wire Wrap Screen
3-1-17C*	1/87	173	161-171	D	33	Stainless Steel Wire Wrap Screen
3-1-18A*	11/86	63	39-54	S	44.2	Stainless Steel Wire Wrap Screen
3-1-18B*	1/87	125	108-118	I	45.5	Stainless Steel Wire Wrap Screen
3-1-18C*	1/87	153	130-140	D	42.8	Stainless Steel Wire Wrap Screen
3-1-19*	5/86	45	35-45	S	38.0	Stainless Steel Wire Wrap Screen

Table 3-17. Well Completion Summary (Sheet 2 of 3)

WELL Number	DATE INSTALLED	DRILLED DEPTH (ft)	COMPLETION INTERVAL (ft)	GROUNDWATER ZONE MONITORED	DEPTH TO WATER (ft)	COMPLETION TYPE
3-2-1*	11/48	77	18-75	S	40	Perforated Steel Casing
3-2-2*	10/76	65	35-55	\$ \$ \$ \$ \$ \$	39	Stainless Steel Wire Wrap Screen
3-2-3*	10/76	65	35-55	S	40	Stainless Steel Wire Wrap Screen
3-3-1*	10/48	74	20-65	S	43	Perforated Steel Casing
3-3-2	10/47	102	40-75	S	53	Perforated Steel Casing
3-3-3	1/48	175	52-81	S	52	Perforated Steel Casing
3-3-4	5/51	40	-	-	_	Abandoned
3-3-5	5/51	40	-	-	-	Abandoned
3-3-6	8/43	85	42-55	S	48	?
3-3-7	1/44	86	45-60	S	63	?
3-3-8	3/70	48	28-48	\$ \$ \$ \$ \$ \$ \$	43	Perforated Steel Casing
3-3-9	8/76	70	45-55	S	45	Stainless Steel Wire Wrap Screen
3-3-10*	9/76	67	34-49	S	40	Stainless Steel Wire Wrap Screen
3-3-11	9/76	72	47-70	\$	47	Stainless Steel Wire Wrap Screen
3-3-12	9/80	65	35-49	S	46	Perforated Steel Casing
3-4-1	2/51	101	25-80	S	52	Perforated Steel Casing
3-4-2	5/51	42	-	-	-	Abandoned
3-4-3	4/58	100	-	-	-	Abandoned
3-4-4	5/58	40	-	-	-	Abandoned
3-4-5	8/58	196	110-195	I/D	50	Perforated Steel Casing
3-4-6	7/58	134	-	•	-	Abandoned
3-4-7	11/61	155	21-82	S -	35	Perforated Steel Casing
3-4-8	10/71	72	35-53	S	41	Perforated Steel Casing
3-4-9	9/76	65	38-58	S	32	Stainless Steel Wire Wrap Screen
3-4-10	9/76	60	37-50	\$ \$ \$	33	Stainless Steel Wire Wrap Screen
3-4-11	11/86	95	55-70		59.9	Stainless Steel Wire Wrap Screen
3-5-1	2/51	102	23-95	S/I	52	Perforated Steel Casing
3-5-2	7/54	424	192-424	D .	40	Perforated Steel Casing
3-5-3	5/51	36	←	-	-	Abandoned

Table 3-17. Well Completion Summary (Sheet 3 of 3)

WELL NUMBER	DATE INSTALLED	DRILLED DEPTH (ft)	COMPLETION INTERVAL (ft)	GROUNDWATER ZONE MONITORED	DEPTH TO WATER (ft)	COMPLETION TYPE
3-6-1	5/50	101	25-62	S	42	Perforated Steel Casing
3-8-1	4/50	102	35-83	S	57	Perforated Steel Casing
3-8-2	5/50	119	43-106	S/I	53	Abandoned
3-8-3	3/51	102	25-99	s [']	50	Abandoned
3-8-4	9/79	65	42-60	S	45	Abandoned

^{*} Wells included in that portion of the Hanford Groundwater Data Base (PNL, 1988b) made available for the preparation of this document.

D = Deep

I = Intermediate

S = Shallow

Schalla et al., 1988

Table 3-18. Shallow Groundwater Quality in Operable Unit 300-FF-1 (Sheet 1 of 2)

					
PARAMETERS	DETECTED	<u>UNITS</u>	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
gross alph gross beta pH**		pCi/L pCi/L std. ur	4 8 nits 0.1	208 121 6.4, 8.5	317/324 351/421 405/412
specific c	onductance	μmho/cm		456	404/413
total coli		mpn/100		43	161/319
	nic carbon**	μg/L	1,000	8,030	63/272
total organ	nic halogen**	μg/L	100	24,500	32/272
aluminum	(total)**	μg/L	150	1,210	25/287
	(filtered)**	μg/L	150	700	2/173
arsenic	(total)**	μg/L	5	17	8/287
barium	(total)** (filtered)**	μg/L	6	719 66	323/323 173/173
cadmium	(total)**	μg/L μg/L	5 6 6 2 ?	6.6	10/323
carbon	(total)#	μg/L	2	25,700	15/15
chromium	(total)**	μg/L	10	257	17/322
	(filtered)**	μg/L	10	21	1/173
copper	(total)**´	μg/L	10	516	148/287
	(filtered)**	μg/L	10	48	84/173
iron	(total)**	μg/L	50	8,300	172/287
	(filtered)**	μg/L	50	4,870	18/173
lead	(total)**	μg/L	5	. 173	35/356
maanaaium	(filtered)**	μg/L	5 5 ? ? 5 5	6.1	2/147
magnesium	(total) (filtered)	μg/L	;	11,800	160/160
manganese	(total)**	μg/L	í É	13,200 191	173/173
manganese	(filtered)**	μg/L μg/L	5 5	53	20/287 10/173
mercury	(total)**	μg/L	0.1	8.9	9/287
nickel	(total)**	μg/L	10	95	8/287
	(filtered)**	μg/L	10	39	6/173
potassium	(total)**	μg/L	100	6,040	287/287
_	(filtered)**	μg/L	100	5,910	173/173
silver	(total)**	μg/L	10	19	1/287
sodium	(total)**	μg/L	100	29,700	287/287
atrod from	(filtered)**	μg/L	100	258,000	173/173
strotium	(filtered)**	μg/L	300	310	1/23
uranium vanadium	(total)** (total)**	μg/L	0.725	446	136/136
vanda lam	(filtered)**	μg/L μg/L	5 5	30 11	63/287 29/173
zinc	(total)**	μg/L μg/L	5 5 5	260	104/185
	(filtered)**	μg/L	5	. 47	44/173
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Table 3-18. Shallow Groundwater Quality in Operable Unit 300-FF-1 (Sheet 2 of 2)

PARAMETERS DETECTED	<u>UNITS</u>	DETECTION <u>LIMIT</u>	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
ammonium** chloride** cyanide** fluoride nitrate** phosphate** sulphate sulfide**	μg/L μg/L μg/L μg/L μg/L μg/L μg/L	50 500 10 500 500 1,000 500	1,630 122,000 11 1,870 82,000 3,240 47,900 3,000	90/290 385/386 1/283 184/479 495/497 2/386 386/386 4/269
chloroform** bis(2-Ethyl hexyl) phthalate** methylene chloride** methyl ethyl ketone tetrachloroethylene**	μg/L μg/L μg/L μg/L μg/L	10 10 10 10	50 3,040 18 39	340/402 2/33 40/329 4/417 15/427
cobalt-60** hydrogen-3** strontium-90** technetium-99** uranium**	pCi/L pCi/L pCi/L pCi/L pCi/L	22.5 500 5 15 0.5	64 6,480 5.6 55 120	5/142 34/131 · 2/22 5/9 172/174

^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile.

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[#] Only one background data point.

Table 3-19. Intermediate Depth Groundwater Quality in Operable Unit 300-FF-1 (Sheet 1 of 2)

					
PARAMETERS	<u>DETECTED</u>	UNITS	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
	nductance	pCi/L pCi/L std. ur umho/cm mpn μg/L μg/L		47.3 29.9 6.7, 8.3 370 3 3,850 2,940	22/35 29/35 38/39 38/39 9/35 4/35 3/35
aluminum cadmium calcium carbon	(total)** (total)** (total)** (filtered)** (total)#	μg/L μg/L μg/L μg/L μg/L	150 2 50 50 ?	180 9 24,300 24,900 40,700	1/35 2/35 26/26 24/24 3/3
chromium copper barium	(total)** (total)** (filtered)** (total)** (filtered)**	μg/L μg/L μg/L μg/L μg/L	10 10 10 6 6	19 42 11 80 69	7/35 8/35 1/24 35/35 24/24
iron lead	(total)**' (filtered)** (total)**	μg/L μg/L μg/L	50 50	1,130 140 5.6	21/35 11/24 1/35
magnesium	(total)* (filtered)** (total)**	μg/L μg/L	5 ? 5 5	7,060 7,220 91	26/26 24/24
manganese mercury	(filtered)** (total)**	μg/L μg/L μg/L	0.1	96 0.2	35/35 24/24 1/35
nickel potassium	(total) (total) (filtered)	μg/L μg/L μg/L	10 100 100	16 6,650 6,120	1/35 35/35 24/24
sodium uranium	(total) (filtered) (total)#	μg/L μg/L μg/L	100 100 0.725	61,400 54,200 24.8	35/35 24/24 2/2
vanadium	(total)** (filtered)**	μg/L μg/L	5 5	8 6	1/35 1/24
zinc	(total) (filtered)	μg/L μg/L	5 5	53 18	13/26 7/24
ammonium chloride** fluoride nitrate** sulfate		μg/L μg/L μg/L μg/L μg/L	50 500 500 500 500	595 38,500 1,770 17,600 18,900	22/35 35/35 25/35 22/35 35/35

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Table 3-19. Intermediate Depth Groundwater Quality in Operable Unit 300-FF-1 (Sheet 2 of 2)

PARAMETERS DETECTED	<u>UNITS</u>	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
chloroform**	μg/L	10	16	3/34
trans-1,2- dichloroethylene** methylene chloride** methyl ethyl ketone trichloroethylene**	μg/L μg/L μg/L μg/L	10 10 10 10	72 1,500 23 24	14/18 4/33 1/39 8/39
strontium-90 uranium**	pCi/L pCi/L	5 0.5	5.3 30.9	1/4 4/9

^{*} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile.

Appendix B

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^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.99 background quantile.

^{#.} Only one background data point.

Table 3-20. Deep Groundwater Quality in Operable Unit 300-FF-1

PARAMETERS	DETECTED	UNITS	DETECTION LIMIT	MAXIMUM VALUE <u>DETECTED</u>	DETECTIONS/ ANALYSES
gross alpha** gross beta** pH specific conductance		pCi/L pCi/L std. un umho/cm		4.2 54.7 6.7, 8.3 517	1/18 14/18 21/21 21/21
aluminum barium calcium chromium	(total)** (total)** (filtered)** (total)** (filtered)** (total)	μg/L μg/L μg/L μg/L μg/L μg/L	150 6 6 50 50	540 129 125 21,200 19,200	3/18 17/18 17/18 17/18 17/18 9/18
iron magnesium manganese	(total)** (filtered)** (total)** (filtered)** (total)**	μg/L μg/L μg/L μg/L μg/L	50 50 ? ? 5	1,380 560 7,860 7,600 90	16/18 12/18 17/18 17/18 17/18
nickel potassium	(filtered)** (total) (filtered)** (total)** (filtered)**	μg/L μg/L μg/L μg/L μg/L	10 10 100 100	80 32 11 11,300 11,100	17/18 3/18 1/18 17/18 17/18
sodium uranium zinc	(total) (filtered) (total)# (total) (filtered)*	μg/L μg/L μg/L μg/L μg/L	100 100 0.725 5 5	68,300 71,400 2.51 60.0 41.0	17/18 17/18 1/2 11/18 3/18
ammonium chloride fluoride		μg/L μg/L μg/L	50 500 500	158 16,200 2,080	17/18 17/18 17/18
nitrate** sulfate		μg/L μg/L	500 500	1,800 12,000	4/18 10/18
trans-1,2- dichloroethylene**		μg/L	10	20	1/8
uranium		pCi/L	0.5	2.66	2/8

^{*} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.95 background quantile.

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^{**} Maximum value detected exceeds the upper 95 percent confidence limit for the 0.99 background quantile.

[#] Only one background data point.

The distributions of selected elevated parameters were evaluated to preliminarily determine the extent of groundwater contamination within the shallow zone, evaluate potential contaminant sources, and to identify contaminants of concern. The 300-FF-5 operable unit work plan will present a detailed evaluation of all existing groundwater data.

3.1.3.2.1 Radionuclides. Radionuclides have previously been identified as contaminants within soils of the 300-FF-1 operable unit. The extent of radionuclide contamination within the groundwater is preliminarily evaluated by examining the distribution of uranium in the shallow aquifer zone.

A recent delineation of the plume of uranium contamination beneath the 300 Area is presented in Figure 3-2 (Schalla et al., 1988). The highest levels are found in those areas near the process trenches, particularly the south end of the trenches. The plume emanates from the trenches in a southeasterly direction, corresponding to the average local groundwater flow direction. The higher concentrations of uranium near the south end of the process trenches are consistent with generally higher soil concentrations of lo alpha towards the southern end of the trenches. Measurements of uranium within soils of the south and north process ponds indicated that uranium concentrations decreased rapidly with increasing distance from the pond inlets. Contaminants in particulate form would be expected to rapidly settle upon entering the waste disposal facilities. This should be particularly true for uranium because of its high density.

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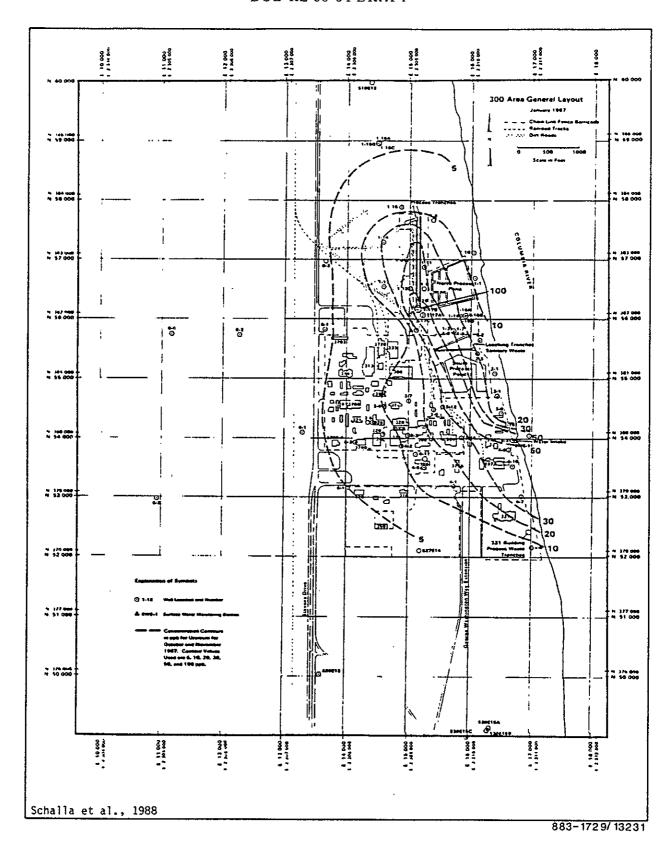
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Figure 3-3 is a plot of the distribution of maximum uranium concentrations within the shallow groundwater zone during 1987. Plots of maximum annual values do not precisely delineate groundwater plumes; however, they do provide preliminary indications of contaminant extent. Such plots are routinely used in Hanford Site groundwater data presentations (see, for example, Evans et al., 1988). This less representative figure seems to indicate the possibility of a second source of groundwater contamination within the southern portion of the operable unit. Potential sources within this area are the 307 retention basins, or the leakage from the radioactive or process sewer pipelines. A documented spill from the radioactive sewer has been recorded in this area.

Other radiation parameters found in elevated levels beneath the operable unit include gross alpha, gross beta, and tritium. The amount of gross alpha contamination can be attributed to the uranium present (Schalla et al., 1988).

3.1.3.2.2 Volatile Halogenated Aliphatic Hydrocarbons. Only a few organic compounds have been detected within the groundwater under the 300-FF-1 operable unit. Specific compounds identified are methylene chloride, tetrachloroethylene, trichloroethylene, trans-1,2-dichloroethylene, and chloroform. Chloroform is apparently derived from the chlorinated water disposed in the process trenches. Given the presence of chloroform, other trihalomethanes, formed as a result of the chlorination process, could also be present. The remaining compounds are all chlorinated solvents known to have been used within the 300 Area. Analyses have also detected total organic carbon (TOC) and total organic halogen (TOX) at elevated levels.



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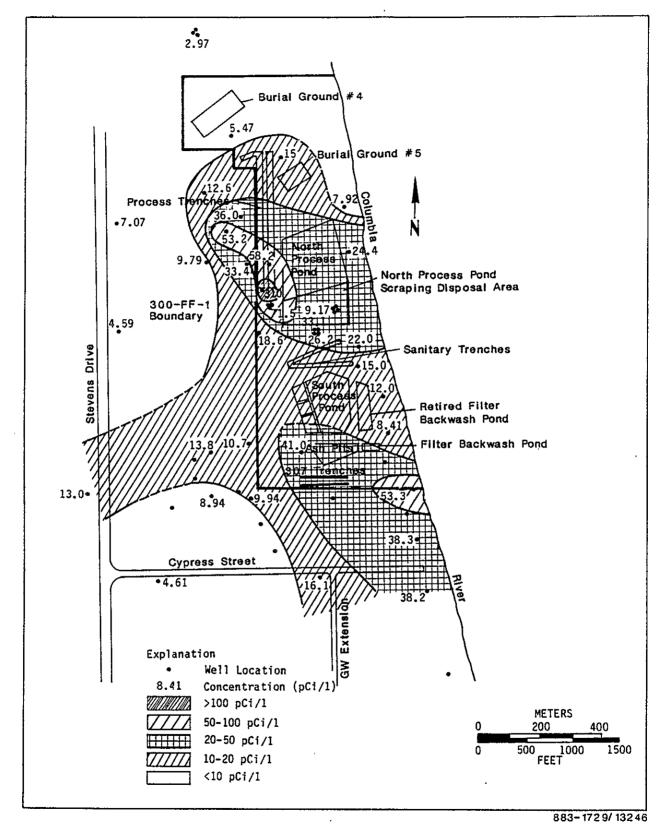
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Figure 3-3. Maximum Uranium Concentrations in Shallow Groundwater (1985-1987)

Analyses for organic compounds in groundwater are summarized in Table 3-21. Methylene chloride is found more frequently and a higher concentrations (up to 1,650 g/l) than the other chlorinated solvents. Methylene chloride, tetrachloroethylene, TOC, and TOX are usually detected at elevated concentrations at the same location, though not during every sampling round. With the exception of intermediate well 3-1-8, these compounds are also only detected in the shallow wells.

The chloroform plume for the 300 Area is presented in Figure 3-4 (Schalla et al., 1988). Maximum concentrations for chloroform generally range between 20 and 40 g/l. As is apparent from the plume, the distribution of this contaminant is directly related to the process trenches.

The distribution of maximum detected concentrations of methylene chloride in shallow groundwater is shown in Figure 3-5. Elevated concentrations are generally found in the vicinity of the process trenches, suggesting this facility as a possible source. Both methylene chloride and tetrachloroethylene have been detected in process trenches soils. Elevated concentrations are also observed in the southern portions of the operable unit, but not in the central portion. The source of methylene chloride in the southern wells is not readily identifiable based on the limited data available, but could possibly be related to discharges of cleaning solvents from the sanitary trenches. Some Hanford Site scientists question the validity of the methylene chloride data, attributing them to sampling or laboratory contamination (Schalla et al., 1988).

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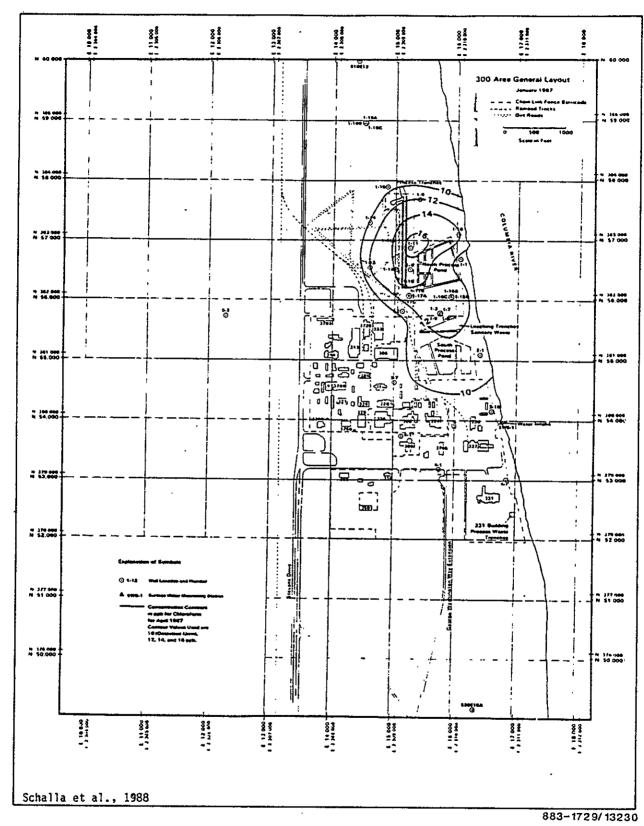
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Referring again to Table 3-21, it can be seen that trichloroethylene and trans-1,2-dichloroethylene occur at entirely separate locations than do the other detected organic parameters. Both of these compounds occur only in the intermediate and deep wells downgradient of the process trenches and north process pond. With the exception of the deep well (3-1-16C), these parameters have been consistently detected at these locations. The existence of these parameters only at depth could indicates that these compounds were probably the result of a previous and significant solvent spill. These compounds may have migrated to the unconfined aquifer base as a separate, dense, nonaqueous phase liquid (DNAPL). A release of approximately 120 kg (260 lb) of tetrachloroethylene to the process sewer has been documented. As both trichloroethylene and trans-1,2-dichloroethylene are degradation products of tetrachloroethylene, this spill and others like it could account for the observed concentrations at depth. The extent of contamination within the lower portion of the unconfined aquifer (the intermediate zone) can not be assessed without data from additional sampling points.

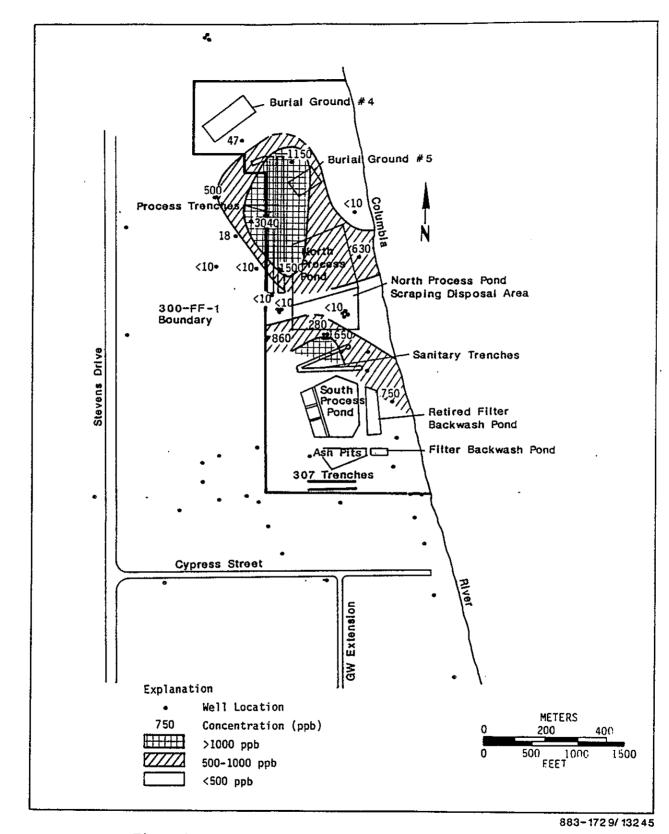
3.1.3.2.3 Metals. A large number of metals has been detected at elevated concentrations within the soils of the process sewage disposal facilities in the 300-FF-1 operable unit. A few metals are also found in the groundwater at concentrations highly elevated above preliminary background conditions. Copper distributions are used to illustrate the approximate extent of metals contamination in groundwater. Copper has been shown to be associated with high levels of radioactivity in the soils of the process ponds (Dennison et al., 1988).



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Figure 3-4. Concentration Contours for Chloroform for April 1987



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Figure 3-5. Maximum Methylene Chloride Concentrations in Shallow Groundwater (1985-1987)

Table 3-21. Summary of Chlorinated Organic Parameters Detected in Groundwater Within the 300-FF-1 Operable Unit

								trans-1	.2					
Well	Completion	Methylene C		Tetrachloroe		Trichloroe		Dichloroet			OC	ŢOX		
Number	Interval (ft)	Maximum(a)	D/A ^(b)	Maximum(a)	D/A ^{b}	Maximum(a)	D/A ^(b)	Maximum(a)	D/A ^(b)	Maximum ⁽	a) _{D/A} (b)	Maximum(a)	D/A ^(b)	
3-1-1	20-75	630	5/21	<10	0/37	<10	0/37	<10	0/1	3140	6/31	421	4/30	48
-1-2	25-75	860	4/18	13	2/37	<10	0/37	<10	0/1	3340	6/31	24500	3/30	5
3-1-3	25-70	280	2/12	14	1/23	<10	0/23	-		4320	5/22	119	1/22	5
3-1-4	23-70	3040	4/15	<10	0/26	<10	0/26	<10	0/1	2190	10/25	4470	3/24	5
3-1-5	23-45	1600	8/25	19	6/30	<10	0/30	<10	0/15	8030	13/28	2310	2/28	7
3-1-6	22-44	1150	5/19	<10	0/27	<10	0/27	<10	0/1	1480	7/25	1620	3/24	7
3-1-7	25-75	1650	4/17	39	3/25	<10	0/25	<10	0/3	4670	6/24	2210	3/23	8
3-1-8	85-105	1500	4/17	<10	0/23	<10	0/23	<10	0/2	3850	4/22	2940	2/21	8
3-1-9	170-180	<10	0/7	<10	0/7	<10	0/7	<10	0/1	<1000	0/6	<100	0/5	8
3-1-10	24.5-39.5	<10	0/8	<10	0/8	<10	0/8	<10	0/1	<1000	0/7	<100	0/6	. 8
3-1-11	27-47	18	1/44	<10	0/44	<10	0/44	<10	0/1	1180	1/7	<100	0/6	8
3-1-12	45-60	<10	0/8	<10	0/8	<10	0/8	<10	0/1	<1000	0/7	<100	0/6	8
3-1-13	38-53	<10	0/12	<10	0/12	<10	0/12	<10	0/2	<1000	0/6	<100	0/6	8
3-1-14	31-46	500	2/8	<10	0/8	<10	0/8	<10	0/1	<1000	0/7	513	1/6	8
3-1-15	29-44	47	1/8	<10	0/8	<10	0/8	<10	0/1	<1000	0/7	<100	0/6	8
3-1-16A	32.5-47.5	<10	0/11	<10	0/11	<10	0/11	<10	0/6	<1000	0/6	<100	0/5	8
3-1-16B	105-115	<10	0/8	<10	0/8	24.1	8/8	72	8/8	<1000	0/6	<100	0/5	8
3-1-16C	167.5-177.5	<10	0/8	<10	0/8	<10	0/8	20	1/8	<1000	0/6	<100	0/5	8
3-1-16D	106-116	<10	0/1	<10	0/1	<10	0/1	<10	0/1	<1000	0/1	<100	0/1	8
3-1-17A	25-40	<10	0/45	<10	0/45	<10	0/45	<10	0/4	1090	1/7	<100	0/1	8
3-1-17B	100-110	. <10	0/7	<10	0/7	<10	0/7	31	6/7	<1000	0/6	<100	0/5	8
3-1-17C	161-171	<10	0/7	<10	0/7	<10	0/7	<10	0/3	<1000	0/6	<100	0/5	8
3-1-18A	39-54	<10	0/7	<10	0/7	<10	0/7	<10	0/1	<1000	0/7	<100	0/6	8
3-1-18B	108-118	<10	0/6	<10	0/6	<10	0/6	<10	0/1	<1000	0/6	<100	0/5	8
3-1-18C	130-140	<10	0/6	<10	0/6	<10	0/6	<10	0/1	<1000	0/6	<100	0/5	8
3-1-19	35-45	<10	0/42	<10	0/42	<10	0/42	<10	0/15	1650	2/6	<100	0/5	8
3-2-1	55-70	750	4/16	18	1/26	<10 ·	0/26	<10	0/1	5460	6/25	1030	2/24	4

⁽a) Maximum detected concentration in ug/L (b) Number of detections/Number of analyses

The distribution of maximum filtered copper concentrations in shallow groundwater between 1985 and 1987 is shown in Figure 3-6. Elevated copper concentrations are closely associated with the process trenches, and are more uniformly distributed beneath the trenches than uranium.

Other elevated metals found in the groundwater beneath 300-FF-1 include aluminum, arsenic, and iron (Schalla et al., 1988).

3.1.3.2.4 Non-metallic Ions. The distribution of maximum chloride concentrations in shallow groundwater is shown in Figure 3-7. Elevated concentrations of chloride appear to be closely associated with the process trenches. Table 3-4 indicates that about 75 tons of sodium chloride are discharged to the process trenches annually.

The approximated extent of the contamination is very similar to that observed previously for uranium, although the southern extent is poorly defined. Slightly elevated concentrations of chloride to the northwest, due to gradient reversals or perhaps an upgradient source, are also indicated.

Other important non-metallic ionic contaminants in 300-FF-1 groundwaters include nitrate and fluoride (Schalla et al., 1988).

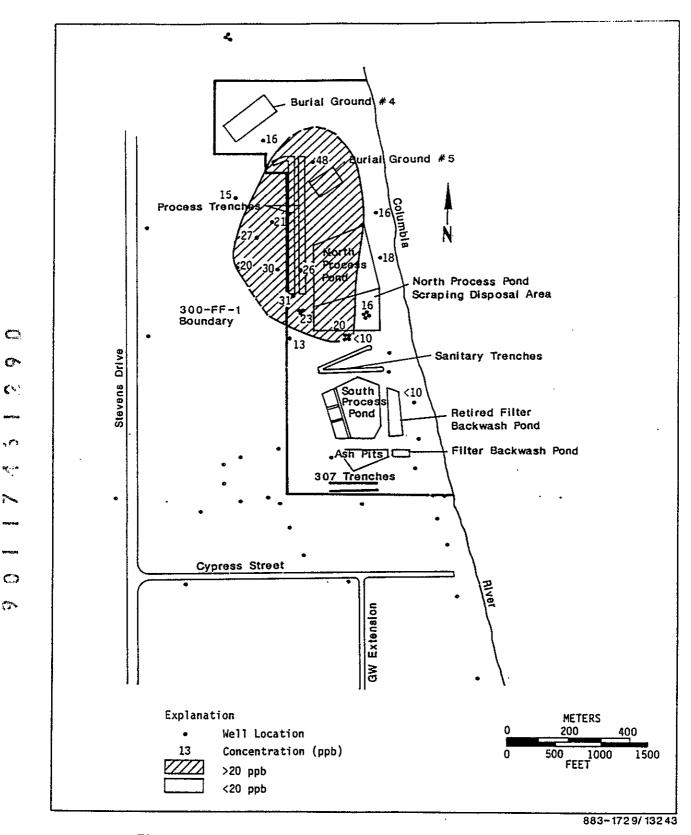
3.1.4 Surface Water and Sediments

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- 3.1.4.1 Background Surface Water Quality. Background values for selected radionuclides and water quality parameters have been reported for the Columbia River water (PNL, 1988). Background has been determined at two upstream locations—the Priest Rapids Dam and the Vernita Bridge—and are presented in Tables 3-22 and 3-23. These values, however, are not suitable for use at the 300 Area, as the upstream stations are located far upstream and many other Hanford related and agricultural activities have the potential to impact the quality of the Columbia River as well.
- 3.1.4.2 Surface Water Contamination. Average values measured at the 300 Area and City of Richland water intakes are presented in Tables 3-24 and 3-25. Those parameters which exceed the average background values plus two standard errors of the mean are denoted as significantly elevated. Because of the location of the background stations, the elevation of the parameters can not be strictly attributed to operable unit 300-FF-1.

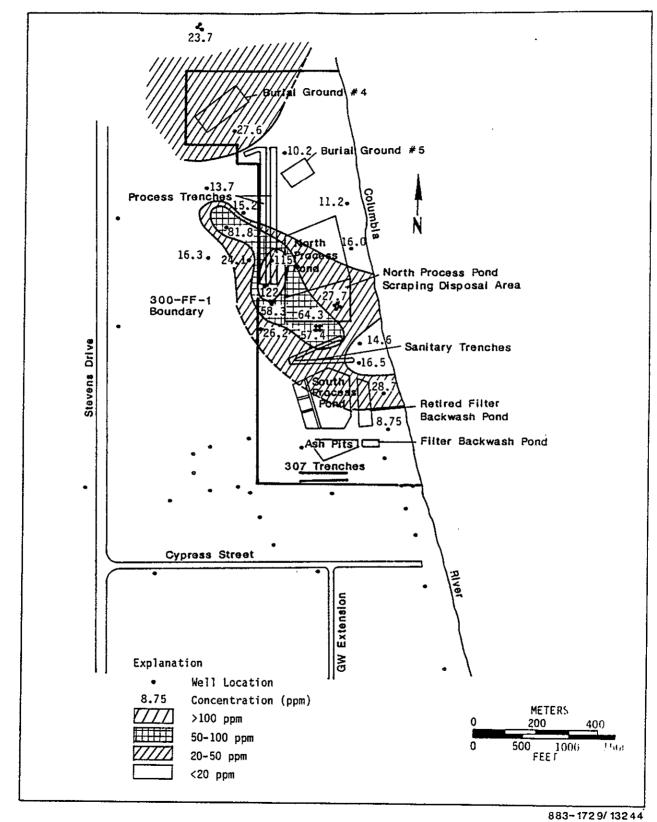
Downstream levels of nitrate, TOC, and phosphorous, although low, exceed upstream averages by greater than two standard errors of the upstream mean. Average downstream concentrations of gross beta, tritium, strontium-89, uranium (isotopes 234, 238, and total uranium), and iodine-129 are all greater than average background concentrations plus two standard errors of the background average. Concentrations of all of these radionuclides are below drinking water standards by at least an order of magnitude.



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Figure 3-6. Maximum Filtered Copper Concentrations in Shallow Groundwater (1985-1987)



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Figure 3-7. Maximum Chloride Concentrations in Shallow Groundwater (1985-1987)

Table 3-22. Upstream Water Quality Data for the Vernita Bridge

			CON	ICENTRAT I	ON		
ANALYSIS	UNITS	NO. OF SAMPLES	MAXIMUM	MINIMUM	AN IMUM AVE		L (a)
pH fecal coliform total coliform biological oxygen demand nitrate	std. units #/100 ml #/100 ml mg/L mg/L	12 12 12 12 12	8.3 64 2400 8.3 0.17	7.3 2 2 0.4 0.02	NA 5* 110* 2.48 0.09	± ±	1.25 0.03
temperature dissolved oxygen turbidity pH'	°C mg/L NTU std. units	365(b) 6 6	20.2 ^(b) 13.3 2.6 8.4	9.6 0.1 7.9	11.7 11.2 1.2 NA	<u>+</u> +	1.4
fecal coliform suspended solids, 105°C dissolved solids, 180°C specific conductance hardness, as CaCO ₃ phosphorus, total	#/100 ml mg/L mg/L µmhos/cm mg/L mg/L	6 6 6 6 6 3	16 92 161 76 0.03	<1 7 70 127 59 0.01	1.5* 7.8 77 138 67 0.02	+ + + + + +	6.2 7 11 7 0.01
cfromium, dissolved _itrogen, Kjeldahl _otal organic carbon iron, dissolved ammonia, dissolved (as N)	μg/L mg/L mg/L μg/L mg/L	3 6 4 4 6	1 0.7 40 11 0.07	<0.02 1.2 3 <0.01	<1 0.4 11.2 5.3 0.03	± ± ±	0.1 19.2 3.9 0.02

⁽a)Average value \pm 2 standard errors of the calculated mean (* = annual median)

PNL, 1988

⁽b)Daily averages

Table 3-23. Upstream Water Quality Data for the Priest Rapids Dam

				CONCENTRATI	ON (pCi/L)		
RADIONUCLIDE	NO. OF SAMPLES	MAXI	_{МИМ} (а)	MI	NIMUM(a)		AVERAGE(b)
gross alpha gross beta 3H 89Sr 90Sr 234U 235U 238U U-Total	12 12 12 12 12 12 12 12	0.92 2.1 110 0.10 0.18 0.29 0.028 0.37 0.57	± 0.46 ± 1.4 ±10 ± 0.08 ± 0.04 ± 0.05 ± 0.022 ± 0.06 ± 0.07	0.19 0.19 50 -0.06 0.10 0.17 0.004 0.15 0.33	± 0.28 ± 0.92 ±10 ± 0.12 ± 0.03 ± 0.04 ± 0.006 ± 0.04 ± 0.05	0.44 0.92 70 0.015 0.14 0.24 0.013 0.21 0.46	± 0.16 ± 0.52 ±10 ± 0.041 ± 0.02 ± 0.02 ± 0.006 ± 0.03 ± 0.04
60Co p(c) 95Nb P 95Zr P 106Ru P 129I D 134Cs P 137Cs P 144Ce P 238Pu P 239,240Pu P	24 24 24 24 24 24 24 24 24 24 24 24 24 2	0.0038 0.0074 0.0043 0.0071 0.0043 0.0010 0.020 0.034 0.000012 0.011 0.039 0.0023 0.0052 0.0052 0.0085 0.0085 0.0081 0.056 0.000008	± 0.009 ± 0.008 ± 0.003 ± 0.0034 ± 0.021 ± 0.065 ± 0.064 ± 0.000001 ± 0.007 ± 0.0035 ± 0.0074 ± 0.0018 ± 0.010 ± 0.017 ± 0.071	-0.0070 -0.0066 -0.004 -0.0072 -0.004 -0.012 -0.054 -0.10 0.000004 -0.005 0.001 -0.005 -0.010 -0.012 -0.057 -0.085 -0.000006 -0.000005 0.000006	± 0.007 ± 0.013 ± 0.004 ± 0.0072 ± 0.004 ± 0.019 ± 0.046 ± 0.095 ± 0.0000004 ± 0.0057 ± 0.0057 ± 0.011 ± 0.051 ± 0.069 ± 0.000036 ± 0.00005 ± 0.000002	-0.0006 -0.0004 0.0007 0.0006 0.0007 -0.0010 -0.013 -0.032 0.000007 0.008 0.013 -0.004 0.0006 0.0017 -0.0014 -0.011 -0.013 0.0000002 0.000012 0.000019	± 0.0015 ± 0.0026 ± 0.0012 ± 0.0012 ± 0.0037 ± 0.0010 ± 0.0021 ± 0.0021 ± 0.0021 ± 0.0021 ± 0.0021 ± 0.0026 ± 0.006 ± 0.0026 ± 0.000001 ± 0.000001 ± 0.000024 + 0.000012

 $^{^{(}a)}$ Maximum and minimum value \pm 2 standard deviations of the counting error

PNL, 1988

⁽b) Average value \pm 2 standard errors of the calculated mean (* = annual median)

 $⁽c)_{P}$ = particulate fraction, D = dissolved fraction

Table 3-24. Downstream Water Quality Data For the Richland Pumphouse

	,		CON	NCENTRATI	ON		
ANALYSIS	UNITS	NO. OF SAMPLES	MAXIMUM	MINIMUM	AA BVA	INUAL RAGE	(a)
pH fecal coliform total coliform biological oxygen demand nitrate**	std. units #/100 ml #/100 ml mg/L mg/L	12 12 12 12 12	8.3 240 240 3.0 0.77	7.2 2 2 0.5 0.05	NA 22* 49* 2.0 0.2	<u>+</u> +	0.5 0.1
temperature dissolved oxygen turbidity** pH fecal coliform Suspended Solids, 105°C dissolved Solids, 180°C	°C mg/L NTU std. units #/100 ml mg/L mg/L	365 4 4 4 4 4	20.4(b) 13.6 10.0 8.2 5 11	9.5 0.7 8.0 1 <1 61	11.3 3.8 1.5* 6.5 76	± ± NA ± ±	2.0 4.3 5.8
specific conductance hardness, as CaCO3 phosphorus, total** chromium, dissolveditrogen, Kjeldahl cotal organic carbon** iron, dissolved	μmhos/cm mg/L mg/L μg/L mg/L mg/L μg/L	4 4 3 4 4	150 75 0.03 <10 0.8 97 14	127 59 0.01 <1 <0.2 1.4 4	134 65 0.025 <7 0.5 35 8	± ± ± ± ± ± ± +	11 7 0.01 0.25 45 4.5
ammonia, dissolved (as N)	mg/L	4	0.04	<0.01	0.02	<u>+</u>	0.01

⁽a) Average value \pm 2 standard errors of the calculated mean (* = annual median)

PNL, 1988

⁽b)Daily averages

^{**}Average value exceeds upstream average by greater than 2 standard error of the upstream mean value

Table 3-25. Downstream Water Quality Data For the 300 Area Intake

				CONCENTRATI	ON (pCi/L)		
RADIONUCLIDE	NO. OF SAMPLES	MAX I	MUM(a)	MI	NIMUM(a)		AVERAGE(b)
Gross alpha Gross beta** 3H** 89Sr** 90Sr 234U** 235U 238U**	4 4 4 4 4 4	0.79 2.8 200 0.20 0.15 0.33 0.021 0.26	± 0.41 ± 1.5 ±10 ± 0.12 ± 0.03 ± 0.05 ± 0.013 ± 0.05 ± 0.07	0.43 1.2 130 -0.011 0.092 0.25 0.004 0.24	± 0.35 ± 1.3 ±10 ± 0.12 ± 0.044 ± 0.05 ± 0.007 ± 0.05	0.59 2.1 170 0.097 0.13 0.30 0.009 0.25	± 0.26 ± 1.0 ±40 ± 0.12 ± 0.04 ± 0.05 ± 0.010 ± 0.03
U-Total**	4	0.61		0.49	\pm 0.07	0.56	<u>+</u> 0.07
60Co p(c) 95Nb P 95Zr P 106Ru P 129I D** 31I P 134Cs P 137Cs P 144Ce P 238Pu D 239,240Pu P	24 24 24 24 24 24 24 24 24 24 24 24 24	0.0048 0.021 0.0047 0.0072 0.0048 0.013 0.0098 0.043 0.00013 0.0079 0.017 0.0035 0.0050 0.0093 0.0031 0.0028 0.045 0.000001 0.000009 0.000009	± 0.0053 ± 0.0053 ± 0.007 ± 0.008 ± 0.019 ± 0.017 ± 0.046 ± 0.00001 ± 0.0061 ± 0.0056 ± 0.0056 ± 0.0039 ± 0.0039 ± 0.00002 ± 0.00002 ± 0.000008	-0.0026 -0.0047 -0.0037 -0.0060 -0.0053 -0.015 -0.028 -0.087 0.000079 0.00009 0.0013 -0.0024 -0.012 -0.0058 -0.014 -0.016 -0.041 0.0000005 -0.00001 0.000008	± 0.0046 ± 0.009 ± 0.0038 ± 0.0059 ± 0.011 ± 0.043 ± 0.067 ± 0.000007 ± 0.0034 ± 0.0160 ± 0.0020 ± 0.0094 ± 0.015 ± 0.000035 ± 0.000005 ± 0.000006	0.00017 0.0032 0.00075 0.0010 0.0002 0.0024 -0.0099 -0.022 0.00011 0.0033 0.0083 0.00024 -0.00035 -0.0015 -0.0019 -0.0054 -0.85 0.0000007 -0.0000003	± 0.0012 ± 0.0030 ± 0.0019 ± 0.0016 ± 0.0034 ± 0.0074 ± 0.0013 ± 0.00003 ± 0.0031 ± 0.0021 ± 0.0021 ± 0.0034 ± 0.0021 ± 0.0034 ± 0.00094 ± 0.00001 ± 0.000001 ± 0.000001

⁽a) Maximum and minimum value \pm 2 standard deviations of the counting error

⁽b) Average value \pm 2 standard errors of the calculated mean (* = annual median)

⁽c)p = particulate fraction, D = dissolved fraction

^{**}Average value exceeds upstream average by greater than 2 standard error of the upstream mean value

PNL, 1988

A cross-sectional survey of uranium concentrations in the Columbia River, upstream and adjacent to the 300 Area, have been conducted. Because this survey was conducted in 1957, the results are probably not indicative of current conditions. The data were obtained along five cross-sections and indicated a uranium plume emanating from the river bank at the 300 Area. The plume had a maximum concentration of 4.80 pCi/L at its head, dissipating to a maximum concentration of 1.05 pCi/L, 1,400 m (4,500 ft) downstream. The plume concentrations were highest in shallow waters adjacent to the river bank and decreased rapidly with increasing distance from the shore. Data obtained from the survey are summarized in Table 3-26.

Site specific measures of coliform bacteria and BOD in river water adjacent to the 300 Area have been reported (Douglas United Nuclear, 1967). These measurements were made upstream and within the seepage area of the 300 Area. Upstream measurements of coliform and BOD were 3.5/100 ml and 3.7 mg/L, respectively. Downstream measurements of 6/100 ml and 3.0 mg/L were not discernably higher than the upstream values.

Concentrations of selected metals, anions, and radionuclides have been reported for bank seepage along the 300 Area during 1967 (Douglas United Nuclear, 1967). These analyses are summarized in Table 3-27. The measured bank seepage concentrations were shown, not surprisingly, to be very comparable to concentrations within groundwater in neighboring wells.

3.1.4.3 Sediments. No information is available on sediment quality within the Columbia River immediately upstream or downstream of the operable unit.

3.1.5 Air

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- 3.1.5.1 Background Air Quality. Background concentrations for airborne radionuclides have been measured at several distant communities in eastern Washington. The average values for these distant communities are indicated in Table 3-28.
- 3.1.5.2 Air Contamination. Concentrations of airborne radionuclides have been extensively monitored both on and off the Hanford Site. Data for the 300 Area are available from three monitoring stations. One of the monitoring stations, the 300 pond, is located in the 300-FF-1 operable unit, at the southwest corner of the process trenches. The available 1987 monitoring data are summarized in Table 3-28.

Average concentrations of gross beta, gross alpha, krypton-85, uranium, and plutonium-240 exceed the measured average background concentrations by greater than two standard errors of the background mean. Given the number of possible sources for airborne radionuclide contamination at the Hanford Site, these data are not strictly representative of contamination directly associated with the 300-FF-1 operable unit.

Table 3-26. Columbia River Cross-Sectional Uranium Survey(a)

TRANSECT	DOWNSTREAM.	NUMBER OF	CON	CENTRATION (pC	
NUMBER	DOWNSTREAM DISTANCE(b)	SAMPLES	MAXIMUM	MINIMUM	AVERAGE
1	0	51	0.73	0.51	0.61
2	350	34	4.80	0.51	0.60
3	850	31	4.54	0.51	0.72
4	1,350	30	1.93	0.51	0.74
5	1,850	35	1.05	0.43	0.65

⁽a) Survey conducted 1957.

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С С> Note: Transect #2 was located approximately due east of the center of the north process pond; transect #3 was located approximately due east of the northern portion of the south process pond.

⁽b) From regional monitoring mile #37 in yards.

Table 3-27. Concentration of Selected Parameters Within Bank Seepage at the 300 Area in 1967

PARAMETER	UNITS	NUMBER OF SAMPLES	AVERAGE CONCENTRATION	MAXIMUM CONCENTRATION
uranium	mg/L	11	0.50	0.36
chromium(VI)	mg/L	10	0.70	0.34
nitrate	mg/L	18	181	129
fluoride	mg/L	8	10.0	5.1
zinc-65	pCi/L	1	91	91
cobalt-60	pCi/L	1	88	88
chromium-51	pCi/L	1	910	910
neptunium-239	pCi/L	1	56,000	56,000
gross beta	pCi/L	ī	280	[^] 280

Douglas United Nuclear, 1967

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Table 3-28. Airborne Radionuclide Concentrations for the 300 Area

PARAMETERS	LOCATION	NUMBER OF SAMPLES	MAXIMUM	CONCENTRATION MINIMUM	(pCi/m ³) AVERAGE	OFFSITE (a)
gross beta	300 Pond	26	59×10 ⁻³	14×10 ⁻³	*30x10 ⁻³	24×10 ⁻³
9,000 5000	300 South Gate	26	55×10 ⁻³	11×10 ⁻³	26×10 ⁻³	24×10 ⁻³
	ACRMS	26	59×10 ⁻³	12×10 ⁻³	*28×10 ⁻³	24×10 ⁻³
gross alpha	300 Pond	26	6.3×10 ⁻³	0.2×10 ⁻³	*2.3×10 ⁻³	0.7×10 ⁻³
,,	300 South Gate	26	1.7×10^{-3}	0.3×10 ⁻³	*0.9x10 ⁻³	0.7×10^{-3}
¹⁴ c	300 Pond	6	1.4	1.2	1.3	1.3
85 _{Kr}	300 Pond	10	230	20	*58	28
131 _I	300 South Gate	26	6.9×10 ⁻³	-6.7×10 ⁻³	0.2×10 ⁻³	·0.7×10 ⁻³
137 _{Cs}	Composite ^(b)	12	0.4×10 ⁻³	-0.5×10 ⁻³	0.1×10 ⁻³	0.3×10 ⁻³
U (total)	Composite ^(b)	4	1.95×10 ⁻³	0.25×10 ⁻³	*1.18×10 ⁻³	0.05×10 ⁻³
238 _{Pu}	Composite(b)	4	1.2×10 ⁻⁶	0.2×10 ⁻⁶	0.7×10 ⁻⁶	0.3×10 ⁻⁶
239,240 _{Pu}	Composite(b)	4	3.7×10 ⁻⁶	0.1×10 ⁻⁶	*1.4×10 ⁻⁶	0.3×10 ⁻⁶

⁽a) Average from distant Washington communities (Moses Lake, Washtucna, Walla Walla, McNary Dam, Sunnyside, Yakima)

Note: Negative values are the result of subtracting instrument background values from analytical results.

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⁽b) Composite from 300 Pond, 300 South Gate, and ACRMS

^{*}Measured average exceeds background average plus two standard errors of the background average

3.1.6 Biota

- 3.1.6.1 Background Biota Quality. Background concentrations of selected radionuclides in native vegetation have been measured at numerous off-site locations. Average background values are included in Table 3-29. No background data for fauna are available.
- 3.1.6.2 Biota Contamination. Limited data exists on radionuclide contamination of flora and fauna within the 300 Area. The existing data are summarized in Table 3-29.

Radionuclide concentrations within the muscle tissue of birds killed within the 300 Area are the only data currently available. Interpretation of this data is difficult in the absence of background data. It is interesting to note, however, that cesium-137 levels are considerably higher within ducks than in pheasants.

Concentrations of radionuclides are generally higher within vegetation on-site than off-site.

3.2 POTENTIAL ARARS

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3.2.1 Identification of ARARs

Section 121(d) of CERCLA requires that remedial actions at NPL sites comply with federal and state environmental laws, promulgated standards, requirements, criteria, and limitations, that are legally applicable or relevant and appropriate under the circumstances presented by the release or threatened release of hazardous substances, pollutants, or contaminants at the site. These ARARs can be grouped into three types; chemical-specific, location-specific, and action-specific (52 FR 32496, Aug. 27, 1987).

Included in Table 3-30 is a list and assessment of potential federal ARARs for the 300-FF-1 operable unit. Potential Washington State ARARs are included in Table 3-31. Normally only chemical-specific and location-specific ARARs are identified during scoping of an RI/FS. Potential action-specific ARARs, however, are included in these tables to illustrate those that may be evaluated during remedial alternative screening in the FS.

Also included in these tables is an assessment of whether the ARAR is applicable, potentially relevant and appropriate, or to be considered. Applicable requirements are defined as those that would be legally applicable to a remedial action if that action were not taken pursuant to CERCLA. Relevant and appropriate requirements are those that apply in circumstances similar to those encountered at NPL sites, where their application would be appropriate, although not legally required.

Tables 3-32 and 3-33 include a comparison of 300-FF-1 contaminant levels for the known waste constituents with chemical-specific ARARs for chemical and radiological contaminants, respectively.

Groundwater monitoring data obtained from 1985 through June 1988 indicate several chemicals have been detected at levels exceeding potential ARARs.

Table 3-29. Fauna and Flora Radionuclide Concentrations for the 300 Area

SAMPLE DESCRIPTION	NUMBER OF SAMPLES	MAXIMUM	CONCENTRATION MINIMUM	(pCi/g) AVERAGE	OFF-SITE(a
Pheasant-muscle tissue 60Co 137Cs	e(b)				
60 _{Co}	1			0.002	
137 _{Cs}	1			0.002	
•					
Mallard duck-muscle t		0.93	0.01	0.41	
Mallard duck-muscle t		0.93	0.01	0.41	
Mallard duck-muscle t 137 _{Cs} Native vegetation(c) 90 _{Sr}	issue ^(b) 4	0.93	0.01 0.008	0.41	0.10
Mallard duck-muscle t 137 _{Cs} Native vegetation(c) 90 _{Sr} 137 _{Cs}	issue ^(b) 4 6				0.10 0.12
•	issue ^(b) 4	0.93	0.008	0.23	

__(a)Average of off-site locations

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^{...(}b)Based as 1987 data

⁽c)Based on 1982 through 1987 data from north of the 300 Area

Table 3-30. Potential Federal ARARs for Operable Unit 300-FF-1 (sheet 1 of 3)

REQU	JIREMENTS	APPLICABLE	POTENTIALLY RELEVANT AND APPROPRIATE	TO BE CONSIDERED	RATIONALE
1.	Contaminant Specific				
1.1	Safe Drinking Water Act - Maximum Contaminant Levels (MCLs)		х .		Groundwater is not used for drinking and institutional controls can prevent future use.
	- Maximum Contaminant Level Goals (MCLGs)		X		However, contaminated groundwater discharges to the Columbia River which is used for drinking water.
1.2	Health Advisories, U.S. EPA Office of Orinking Water			x	Chemicals identified for which health advisories are listed.
1.3	Clean Water Act (PL 92-500) - Federal Water Quality Criteria (FWQC)		х		Contaminated groundwater discharges to the Columbia River.
1.4	RCRA Groundwater Protection Standards (40 CFR Part 264 Subpart F) - Alternate Concentration				ACLs may be relevant and appropriate in accordance with CERCLA 121(d)(2)(B)(ii).
	Limits (ACLs)		X		
1.5	Health Effects Assessment			X	Baseline risk assessment will be conducted for contaminants of concern by all routes of exposure.

Table 3-30. Potential Federal ARARs for Operable Unit 300-FF-1 (sheet 2 of 3)

REQL	JIREMENTS	APPLICABLE	POTENTIALLY RELEVANT AND APPROPRIATE	TO BE CONSIDERED	RATIONALE
1.6	Clean Air Act (41 USC 7401) - Standards for Protection Against Radiation (10 CFR parts 20 and 61) - National Emission Standard for Hazardous Air Pollutant for Radionuclides (40 CFR Part 61)	X X			Remedial alternatives may result in air emissions.
1.7	Environmental Radiation Protection Standards (U.S. DOE Order 5400.3 and 40 Subpart F Part 191)	X CFR		·	Radiation standards for protection of the public in the vicinity of U.S. DOE facilities.
1.8	Toxic Substances Control Act (15 USC 2601)		X		PCBs have been detected in contaminated soils.
2.	Location-Specific				
2.1	Historic Sites, Buildings, and Antiquities Act (16 USC 461)	x			Applicability will be determined during RI and in evaluation of remedial alternatives.
2.2	National Historic Preservation Act (16 USC 470) - Protection of Archeological Resources		•		Applicability will be determined during RI and in evaluation of remedial alternatives.
2.3	Endangered species Act of 1973 (16 USC 1531)		X or	x	Considered in the baseline risk assessment.
2.4	Fish and Wildlife Coordination Act (16 USC 661)	X			Applicable if remedial alternatives affect wetlands and protected habitats.

Table 3-30. Potential Federal ARARs for Operable Unit 300-FF-1 (sheet 3 of 3)

REQU	JIREMENTS	APPLICABLE	POTENTIALLY RELEVANT AND APPROPRIATE	TO BE CONSIDERED	RATIONALE
2.5	Fish and Wildlife Improvement Act (16 USC 742)	X			Applicable if remedial alternatives affect wetlands and protected habitats.
2.6	Fish and Wildlife Conservation Act (16 USC 2901)	n X			Applicable if remedial alternatives affect wetlands and protected habitats.
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3.	Action-Specific				
3.1	Hazardous Waste Requirements (RCRA Subtitle C, 40 CFR, Part 264)	x	or X	•	May be applicable for remedial alternatives involving the generation, transportation, storage, and off-site disposal waste. May be relevant or appropriate for containment alternatives.
3.2	Clean Water Act (PL 92-500) - NPDES permit	X			Remedial actions may include discharge to the Columbia River.
	- Underground Injection Control Regulations (40 CFR Parts 144-147)	X .			Remedial actions may include injection of treated groundwater.
3.3	Occupational Safety and Health Act (29 USC 651) - OSHA Standards (29 CFR Part 1910)				Occupational health and safety requirements.

Table 3-31. Potential State ARARs for Operable Unit 300-FF-1 (Sheet 1 of 4)

REQU	IIREMENTS	APPLICABLE	POTENTIALLY RELEVANT AND APPROPRIATE	TO BE Considered	RATIONALE
1.	<u>Contaminant-Specific</u>				
1.1	Water Pollution Laws and Regulations				
	- Water Pollution Control Ac (Ch. 90.46 RCW)	t X o	r X		Do not contain numeric standards. Require surface and groundwaters of the state to be
•	 Regulation of Public Groundwaters (Ch. 90.44 RCW) 		x		protected to maximize beneficial uses. Require all known available and reasonable
•	- Water Resources Act (Ch. 90.54 RCW)		X		treatment for discharges.
	 Water Quality Standards fo Waters of the State of Washington (Ch. 173-201 WAC) 	r X		·	Contain water quality standards for the Hanford reach of the Columbia River.
	- Public Water Supplies (Ch. 248-54 WAC)		X		Contain standards for public drinking water.
1.2	Solid & Hazardous Waste Laws and Regulations				
	- Hazardous Waste Cleanup Ac (Ch. 70.105B RCW)	t	x		Require remedial actions to attain a degree of cleanup protective of human health and the environment. Guidance on cleanup levels in preparation.

Table 3-31. Potential State ARARs for Operable Unit 300-FF-1 (Sheet 2 of 4)

REQUIREMENTS	APPLICABLE		POTENTIALLY RELEVANT AND APPROPRIATE	TO BE CONSIDERED	RATIONALE
 Department of Ecology Final Cleanup Policy - Technical (July 10, 1984) 				х -	Non-promulgated policy to be considered.
- Dangerous Waste Regulations (Ch. 173-303 WAC)	s X	or	X		Contain requirements equivalent to RCRA for groundwater protection standards.
1.3 State Radiation Standards (Ch. 70.98 RCW and WAC Title 402)			X		Contain state radiation standards.
 Location-Specific Washington Shoreline Management Act (Ch. 90.58 RCW))		x		Controls the develolpment of riparian habitat.
3. Action-Specific					
3.1 Washington Clean Air Act (Ch. 70.94 RCW and Ch. 173-480 WAC	x)	or	x		Contain air emissions standards Applicable to the extent federa laws are applicable. May be relevant and appropriate to the extent they are more stringent than federal law.

Table 3-31. Potential State ARARs for Operable Unit 300-FF-1 (Sheet 3 of 4)

REQU	TREMENTS	APPLICABLE		POTENTIALLY RELEVANT AND APPROPRIATE	TO BE CONSIDERED	RATIONALE
3.2	Hazardous Waste Management Ac (Ch. 70.105 RCW) and Dangerous Waste Regulations (Ch. 173-30; WAC)	S	or	X		Establish priorities for hazardous waste management. May be applicable to alternatives that include generation, treatment, storage or disposal of waste. May be relevant and appropriate for containment alternatives.
3.3	Solid Waste Management. Recovery and Recycling Act (Ch. 70.95 RCW) and Minimum Functional Standards for Solid Waste Handling (Ch. 173-304 WAC)	X	or	x		May be applicable for alternatives requiring management of solid waste. To extent they are more stringent than federal law, may be relevant and appropriate.
3.4	Washington State Water Code (Ch. 90.03 RCW)			x		Water rights law. May be relevant and appropriate for alternatives which include extraction and treatment of groundwater.
3.5	Minimum Standards for Construction and Maintenance of Water Wells (Ch. 173-160 WAC)			X		May be relevant and appropriate for monitoring wells during RI and alternatives which include extraction wells.
3.6	State Waste Discharge Program (Ch. 173-216 WAC)			x		May be relevant and appropriate to alternatives which include discharges to ground.

Table 3-31. Potential State ARARs for Operable Unit 300-FF-1 (Sheet 4 of 4)

REQU	JIREMENTS	APPLICABLE		POTENTIALLY RELEVANT AND APPROPRIATE	TO BE CONSIDERED	RATIONALE
3.7	Underground Injection Control Program (Ch. 173-218 WAC)	x	or	X		May be applicable to alternatives which include underground injection to the extent federal laws are applicable. May be relevant and appropriate to the extent they are more stringent than federal law.
3.8	National Pollution Discharge Elimination System Permit Program (Ch. 173-220 WAC)	X	or	X		May be applicable to alternatives which include discharges to the Columbia River to the extent federal laws are applicable. May be relevant and appropriate to the extent they are more stringent than federal law.

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Table 3-32. Potential ARARs for Non-Radiological Contaminants at Operable Unit 300-FF-1 (μ_q/L)

	1°MCL(a)	2.WCF (P)	MCLG(c)	QCFW-A(d)	QCFW-C(e)	QCHH-W/F ^(f)	QСНН-F(g)
arsenic	50	•	•	360	-	_	<u>-</u>
barium	1,000	-	-	-	-	-	_
cadmium	10	-		2.4 ^(h)	0.81 ^(h)	10	-
chromium	50	-	-	16 ⁽ⁱ⁾	11(i)	50 ⁽ⁱ⁾	(i)
copper	-	1,000	-	12 ^(h)	8.2 ^(h)	-	
iron	-	300	-	-	1.000	300	-
lead	50	-	-	47 ^(h)	1.8 ^(h)	50	-
manganese	-	50	-	-	-	50	100
mercury	2	-	-	2.4	0.012	0.144	0.146
nickel	-	-	-	1.300 ^(h)	₆₉ (h)	13.4	100
selenium	10	_	-	260	35	10	-
silver	50	_	_	1.9 ^(h)	0.12	50	-
zinc	-	5.000	-	220 ^(h)	47	-	-
chloride	_	250,000	•	-	•	-	-
cyanide	-	~	-	22	5.2	200	-
fluoride	4,000	2,000	-	-	-	_	-
nitrate	45,000	-	-	-	-	45,000	_
sulfate	-	250,000	-	•	, -	-	**
рН	-	6.5-8.5	-	-	6.5-9.0	-	
chloroform polychlorinated	100	-	-		-	-	
biphenyls	_	-	_	2.0	0.014	_	_
tetrachloroethylene	-	_	_	2.0	0.017	_	_
trichloroethylene	5	_	0		_	_	_

⁽a) primary maximum contaminant level for drinking water to protect public health (40 CFR 141 and WAC 248).

⁽b) Secondary maximum contaminant level for drinking water to protect public welfare (40 CFR 143 and WAC 248) (c) Maximum contaminant level goal for drinking water to protect public health (50 FR 46936,

[&]quot;Maximum contaminant level goal for drinking water to protect public health (50 FR 46936 November 13, 1985).

⁽d)Quality criterion for ambient surface water to protect freshwater aquatic life (acute) (EPA, 1986a).

⁽e) Quality criterion for ambient surface water to protect freshwater aquatic life (chronic) (EPA, 1986a).

⁽f) Quality criterion for ambient surface water to protect human health (ingestion of water and aquatic organisms) (EPA, 1986a).

⁽g)Quality criterion for ambient surface water to protect human health (ingestion of aquatic organisms only (EPA, 1986a).

⁽h) Hardness dependent criterion, the average value of 65 mg/L for the Columbia River is used.

⁽i) Value for chromium (IV), corresponding values for chromium (III) are 1.200, 150, 170,000, and 3,433,000 μ g/L, respectively.

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Table 3-33. Potential ARARs for Radionuclides at Operable Unit 300-ff-1

CONTANINANT	SITE CONTANINANT LEVELS IN GROUNDLATER (*) H (PCI/L)	TE CONTANINANT FEDERAL AND LEVELS IN STATE DRINKING GROUNDLATER (*) LATER STANDADDS (HCLs) (PGI/L) (PGI/L)	FEDERAL AIR OCALITY STANDARDS	10 CFR 20 ^(d) ENISSION LINITS AIR I SCALBLE/INSOLUBLE SOLUBI (CCI/RI)	10 CFR 20 ^(d) ENISSION LINITS AIR SOLUBIE/INSOLUBLE SOLUBLE/INSOLUBLE (uci/mi) (uc/mi)	ERVIRONNENTAL RADIATION PROTECTION ⁽⁶⁾ STANDADS FOR RADIANCTIVE LASTE DISPOSAL (ALL PATHLAYS) 40 CFR 191 (Ci/unit of waste)	ON PROTECTION ^(G) OACTIVE UNSTE PATHUAYS) 40 CFR 193	CONCE GUIDE . WATER (pc1/L)	CONCENTRATION GUIDES (DCGs) FER AIR //L) (pci/m³)
gross alpha	. 208	(9)51	:	:	:	:	:	:	:
gross beta and gross games	121	(c)	;	;	;	;	;	;	:
cesiun-137	15	200(c)	:	2x10-9 5x10-10	2x10-5 4x10-5	1,000	:	3,000	007
cobalt-60	3	100(c)	i	1x10-8 3x10-10	5x10'5 3x10'5	:	:	2,000	8
ruthenium-106	80.3	30(c)							
strontium-90	5.63	8(c)	;	3×10-11 2×10-10	3x10-7 4x10-5	1,000	:	1,000	3 -
technitium-99	55.2	900(c)							
tritium	0879	20,000 ^(c)							
uranium (natural)	1/6# 955	;	;	2x10-11 4x10-12	3x10-5 3x10-5	100	:	909	0.1
uranium	120	:	:	3x10-12 5x10-12	4x10-5 4x10-5	00t	:	909	0.1
all radionaclides		4 mrostyr (c)	Whole Body: 25 mremyrr Critical Organ: 75 mre Alternate Standards Continuous Exposure: 1 Won-continuous Exposure: 1	Whole Body: 25 mrewyr Critical Organ: 75 mrewyr Alternate Standards Continuous Exposure: 100 mrewyr Won-continuous Exposure: 500 mrewyr	ار المورد الم	Whole Body: 25 mrceVyr25 m Crifical Organ: 75 mrceVyr AlterNate Standards Continuous Exposure: 100 m Non-continuous Exposure: 5	Mhole Body: 25 mrcm/yr25 mrem/yr100 mrem/yr100 mrem/yr Critical Organ: 75 mrem/yr Alternig Signdards Continuous Exposure: 100 mrem/yr Hon-continuous Exposure: 500 mrem/yr	100 accestyr1	00 mrom/yr

(a) Values are maximum levels reported from 1985 through June 1988 groundwater amoitoring program for wells in the vicinity of the 300-FF-1 Operable Unit.
(b) 40 CFR 141.15 - 141.16 excludes radon and uranium. LMC 248-54-175(3) excludes uranium only.
(c) Annual average concentrations shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mram/yr. For known mixtures of radionactides, the sim of the nations of the observed concentrations of each radionactide and its corresponding MCL must not exceed 1.0.
(d) KRC radiation protection standards at boundary of restricted area.
(e) 40 CFR 191 has been invalidated by the Courts and resended back to EPA on groundwater protection issues. Release Limits for radionactides may be delated from these regulations.

3.2.2 Point of Applicability of ARARs

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A significant factor for evaluation of remedial alternatives at the Hanford Site will be determining the point of applicability for compliance with the ARARs. Points of applicability are the boundaries that will be used to assess the effectiveness of remedial alternatives. Determining the point of applicability of ARARs concerning groundwater quality is especially significant for the 300-FF-1 operable unit.

For water that is or may be used for drinking, the maximum contaminant levels (MCLs) set under the Safe Drinking Water Act are generally the applicable or relevant and appropriate standard. EPA's interim guidance on compliance with ARARs states:

MCLs are applicable at the tap where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. Otherwise, where surface water or groundwater is or may be used for drinking, MCLs are generally relevant and appropriate as cleanup standards for the surface water or the groundwater (52 FR 32496, Aug. 27, 1987).

Groundwater affected by the operable unit is not currently used for drinking water at the Hanford Site, and there is no evidence of off-site consumption of groundwater affected by this operable unit. MCLs would not be applicable, but may be relevant and appropriate, cleanup standards, for the 300-FF-1 groundwaters.

The groundwater protection standards for the RCRA program promulgated under 40 CFR Parts 264 and 265, Subparts F, provide EPA and Ecology with the option of establishing alternate concentration limits (ACLs) at hazardous waste facilities. Section 121 (d)(2)(B)(ii) of CERCLA states that ACLs may only be used to establish standards for cleanup of groundwater under the following conditions:

- there are known and projected points of entry of such groundwater into surface water; and
- on the basis of measurements or projections, there is or will be no statistically significant increase of such constituents from such groundwater in such surface water at the point of entry or at any point where there is reason to believe accumulation of constituents may occur downstream; and
- the remedial action includes enforceable measures that will preclude human exposure to the contaminated groundwater at any point between the facility boundary and all known and projected points of entry of such groundwater into surface water.

If these conditions are met, the assumed point of human exposure (point of applicability) may then be at such known or projected points of entry. Based on these criteria, ACLs could be relevant for evaluation of groundwater remedial alternatives for the 300-FF-1 operable unit.

EPA has also published draft guidance on remedial actions for contaminated groundwater at NPL sites that is useful in determining cleanup standards and points of applicability (EPA, 1988a). The guidelines discuss EPA's groundwater protective strategy and procedure for classifying groundwater within a prescribed area around a facility or activity based upon the value, use, and vulnerability of the groundwater. The groundwater protection strategy establishes three classifications of groundwater, each requiring different levels of protection. These include:

- class I special groundwaters (i.e., sole source aquifers)
- class IIa current and potential sources of drinking water, and waters having other beneficial uses
- class IIb potential, but not currently used, source of drinking water, and waters having other potential beneficial uses
- class III groundwater that is not a potential source of drinking water and is of limited potential use due to salinity or widespread contamination

Drinking water standards are applicable or relevant and appropriate cleanup standards for class I and class II groundwaters. Drinking water standards are not applicable or relevant and appropriate for class III waters.

Groundwater in the 300-FF-1 operable unit would probably be classified as class IIb. However, establishment of ACLs could be appropriate, depending on whether institutional controls over groundwater use in the area will continue.

With respect to the Columbia River, MCLs are applicable at the taps in both the 300 Area and the City of Richland, where the river serves as the source of drinking water. In addition, MCLs may be relevant and appropriate cleanup standards for the ambient water column in the river. Federal water quality criteria promulgated under the Clean Water Act may also be relevant and appropriate standards to achieve for the Columbia River.

3.2.3 Consideration of ARARs During Remedial Action

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Evaluation of ARARs is an iterative process that will be conducted at multiple points throughout the RI/FS, namely:

- during the RI, when the baseline risk assessment is conducted, chemical-specific ARARs and advisories, and location-specific ARARs will be identified more comprehensively;
- during development of remedial alternatives in phases I and II of the FS, action-specific ARARs will be identified for each of the proposed alternatives and considered along with other ARARs and advisories; and
- during the detailed analysis of alternatives in the phase III FS, all the ARARs and advisories for each alternative will be examined as a package to determine what is needed to comply with other laws and be protective of human health and the environment.

Following completion of the RI/FS, the remedial alternatives selected must be able to attain all ARARs unless one of the five potentially applicable statutory waivers, provided in section 121 (d)(4)(A) through (F) of CERCLA, is invoked. The five reasons ARARs could potentially be waived at the Hanford Site are:

- the remedy is an interim measure where the final remedy will attain ARARs upon completion (particularly relevant when a site has been divided into operable units);
- compliance will result in greater risk to human health and the environment than other options;
- compliance is technically impracticable;
- the remedy selected will attain a standard of performance equivalent to that required under an ARAR; or
- for state ARARs, the state has not consistently applied (or demonstrated the intention to consistently apply) the ARAR in similar circumstances.

During the design phase of the remedial action, the technical specifications of construction must ensure attainment of ARARs. Environmental monitoring during and after implementation of the selected remedy will also help to ensure that ARARs are complied with.

3.3 POTENTIAL IMPACTS TO PUBLIC HEALTH AND THE ENVIRONMENT

3.3.1 Conceptual Exposure Pathway Model

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Based on information presented thus far, a conceptual model of contaminant exposure pathways for the 300-FF-1 operable unit was developed. The model is presented in Figure 3-8.

The purpose of the conceptual model is to present hypotheses of unitspecific contaminant exposure pathways. Each exposure pathway must contain the following (EPA, 1986b):

- a contaminant source,
- a contaminant release mechanism,
- an environmental transport medium,
- an exposure route, and
- a receptor.

During the RI, the conceptual model hypotheses are tested and refined in an iterative manner until the understanding of the operable unit is sufficient to support subsequent decisions regarding remediation. By conducting the RI in this manner, the project becomes more efficient as the investigation is kept focused on unit-specific objectives.

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Figure 3-8. Contaminant Exposure Pathway Model for the 300-FF-1 Operable Unit 3-73

3.3.2 Preliminary Toxicity Assessment

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Potential contaminants of concern for operable unit 300-FF-1 are presented in Table 3-34. The list was based on the previous evaluation of waste volumes and characteristics and the known nature and extent of contamination. The list contains all waste constituents of primary importance, as identified in Chapter 3.1.1.2. Those parameters which are known to be both highly elevated above background levels (values found above the upper 95% confidence limit for the 0.99 quantile) and commonly found (present in at least 10% of the samples) in the 300-FF-I soil and groundwater environments, as presented in Chapters 3.1.2 and 3.1.3, are also included as target contaminants.

The preliminary toxicity assessment is performed to further focus attention on the those parameters that are most toxic to human and environmental receptors. The assessment compares critical toxicity values for each parameter, where available, to the levels found within the environment. Those parameters which meet or exceed their critical levels will be focused on during the RI/FS. The assessment also provides a means by which to select the level of analytical quality needed for the RI--the lower the parameter's critical toxicity value, the more sensitive the analytical method must be to provide meaningful data for the baseline risk assessment.

Table 3-35 lists the critical toxicity value for each of the 300-FF-1 target parameters. The value chosen, when available, is the strictest potential ARAR for human and wildlife exposures in water (Chapter 3.2). If no potential ARAR is established for a particular target parameter, the critical toxicity value is calculated from available reference dose or carcinogenicity information, as appropriate. Critical toxicity values for carcinogens are expressed as concentrations that would result in a 10^{-6} incremental lifetime cancer risk. EPA has yet to establish acceptable exposure levels for carcinogens, but a 10^{-6} risk level is generally regarded as being insignificantly small compared to natural background exposures. Critical toxicity values for noncarcinogens are expressed as concentrations that would result in the reference dose, the estimated daily exposure that is likely to result in no deleterious effects over a lifetime.

The assessment in Table 3-35 was limited to groundwater because of the restricted spatial distribution of soil contamination within the operable unit, and the fact that access to the unit is controlled.

There is some potential risk associated with the exposed contaminated soils in the process trenches and ponds through inhalation and ingestion exposure routes. The concentration of chromium (VI) in air which corresponds to a 10^{-6} incremental lifetime cancer risk, for example, is only $0.08~\text{ng/m}^3$. This, however, is a risk level based on lifetime, not occupational, exposures. Because the trenches and ponds are situated below the land surface (and are thus less vulnerable to wind erosion), the nearest residence is 1.4~km (0.9 mi) away, and certain pond soil stabilization measures have already been undertaken (Chapters 2.1.4.1.2 and 2.1.4.1.3), there is no significant risk associated with these soils except, perhaps, to those people involved in occupational activities occurring within the contaminated areas.

Table 3-34. Potential Contaminants of Concern(a) For Operable Unit 300-FF-1

gross alpha gross beta pH	strontium thallium vanadium
total coliform	zinc
total organic carbon	21110
total organic halogen	ammonium
3	chloride
aluminum	fluoride
antimony	nitrate
arsenic	nitrite
barium	sulfate
beryllium	
cadmium	arochlor 1248
calcium	chloroform
chromium	trans-1,2-dichloroethylene
copper	methylene chloride
iron	tetrachloroethylene
lead	trichloroethylene
magnesium	•
manganese	cobalt-60
mercury	hydrogen-3
nickel	technetium-99
potassium	uranium-235
selenium	uranium-238
silver	
sodium	

⁽a)Parameters which occur above the upper 95% confidence limit for the 0.99 background quantiles in soil or groundwater and are found in at least 10% of the environmental samples in either medium.

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Table 3-35. Preliminary Toxicity Assessment for 300-FF-1 Operable Unit Groundwater (Sheet 1 of 2)

SUBSTANCE OR PARAMETER	STRICTEST ARAR	CRITICAL TOXICITY VALUE	MAXIMUM VALUE DETECTED(a)
	pCi/L (excluding		208
gross beta	anium and radon) 50 pCi/L		121 pCi/L
	- 8.5 std. units		6.4, 8.5 std. units
total coliform	1 mpn/100 ml		43 mpn
total organic carbon	- mpn/ 100 m		8,030 μg/L
total organic halogen			24, 500 μg/L
aluminum		(5)	700 μg/L
antimony		$14 \mu g/L(b)$	<100 μg/L
arsenic	50 μg/L		<5 μg/L
barium	$1,000~\mu g/L$		125 μg/L
beryllium	0.01 (4)	0.0068 μg/L(c)	<5 μg/L
cadmium	0.81 μg/L ^(d)		<2 μg/L
calcium	11/1		24,900 μg/L
chromium	$11 \mu g/L$		21 μg/L
copperiron	8.2 μg/L ^(d) 300 μg/Ļ		48 μg/L 4,870 μg/L
lead	1.8 μg/L(d)		4,870 μg/L 6.1 μg/L
magnesium	1.0 μg/ ι		13,200 μg/L
manganese	50 μg/L		96 μg/L
mercury	$0.012 \mu g/L$		<0.1 μg/L
nickel	13.4 μg/L ^(d)		39 μg/L
potassium			11,100 μ g/L
selenium	10 μg/L		<5 μg/L
silver	0.12 μg/L		<10 μg/L
sodium	•••		258,000 μ g/L
strontium		70 (1/8)	310 μg/L
thallium		13 μg/L(e)	<5 μg/L
vanadium zinc	47 va/l	700 $\mu g/L(b)$	11 μg/L
21110	47 μg/L		47 μg/L
ammonium			1,630 μg/L
chloride	250,000 μg/L		122,000 μ g/L
fluoride	2,000 μg/L		$2,080 \mu g/L$
nitrate	44,000 μ g/L	000 mm (1 (f)	82,000 μg/L
nitrite	250 000/!	200 μg/L(f)	NT 000(1
sulfate	250,000 μg/L		47,900 μg/L
arochlor 1248 (PCBs)		0.000079 μg/L(c)	<1 μg/L
chloroform	100 μg/L	-	42 μg/L
trans-1,2-dichloroethyle	ne	- ' (3)	72 μg/L
methylene chloride	.	$5 \mu g/L(g)$	$3,040 \mu g/L$
tetrachloroethylene	o/!	$0.7 \mu g/L(g)$	39 μg/L
trichloroethylene	0 μg/L		24 μg/L

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Table 3-35. Preliminary Toxicity Assessment for 300-FF-1 Operable Unit Groundwater (Sheet 2 of 2)

SUBSTANCE OR PARAMETER	STRICTEST	CRITICAL	MAXIMUM VALUE
	ARAR	TOXICITY VALUE	DETECTED(a)
cobalt-60 hydrogen-3 technetium-99 uranium	100 pCi/L 20,000 pCi/L 900 pCi/L		64 pCi/L 6,480 pCi/L 55 pCi/L 120 pCi/L

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(a) Filtered values reported for metals analyses

(b)Concentration at the reference dose for human consumption of water Integrated

Risk Information System (EPA, 1989 [IRIS]) (c)Concentration at the 10⁻⁶ incremental cancer risk level for human consumption of water aquatic organisms (IRIS).

(d) Hardness dependent freshwater quality criterion; the average hardness of 65 mg/L for the Columbia River was used.

(e) Threshold toxicity protection for human consumption of water and aquatic

organisms (IRIS). (f) Concentration protective of salmonid fishes (EPA, 1986a). (g) Concentration at the 10^{-6} incremental cancer risk level for human consumption of water (IRIS).

Table 3-35 shows that no critical toxicity values are available from EPA CERCLA related sources for:

- total organic carbon,
- total organic halogen,
- aluminum,
- calcium,
- magnesium,
- potassium,
- sodium,
- strontium,
- ammonium,
- trans-1,2-dichloroethylene, and
- uranium.

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The first two parameters, total organic carbon and halogen, are gross indicators of contamination. Thus, they would not be expected to have specific toxicity values. Calcium, magnesium, potassium, and sodium are essential nutrients, and for all practical purposes are nontoxic. The lack of standards and toxicity information on strontium also indicates that it is relatively nontoxic.

Aluminum has no current potential ARAR, but water quality criteria development is pending (EPA, 1986a). Aluminum is known to be toxic to aquatic life in certain forms.

Ammonium, while not particularly toxic, is present in equilibrium with ammonia, the principal toxic form of this substance. Ammonia has been reported to be acutely toxic to freshwater organisms at concentrations as low as 530 μ g/L, depending on the pH and temperature of the water (EPA, 1986a).

No standards exist for trans-1,2-dichloroethylene; however, EPA has proposed a maximum contaminant level goal of 70 μ g/L (50 FR 46936, November 13, 1985).

There are no relevant existing EPA standards for uranium. Uranium is, however, a high volume waste constituent, and is perhaps the contaminant of most concern for the operable unit. EPA is currently developing standards for uranium. A value of 3.3 pCi/L is low end of those under consideration (ICF Northwest, 1987).

3.3.3 Contaminants of Concern

Table 3-36 lists those parameters which are known to exceed or approach their critical toxicity values in the 300-FF-1 groundwater. Because groundwater flow is the primary contaminant transport mechanism at the operable unit, these are the parameters upon which the baseline risk assessment and, therefore, the RI/FS should focus.

Aluminum, ammonium, nitrite, trans-1,2-dichloroethylene, and uranium (two isotopes) are retained in this list for the reasons specified in Chapter 3.3.2. Arochlor 1248 is also retained, even though it has never been detected in the groundwater. The extremely low critical toxicity value provides the rationale for this decision.

Table 3-36. Contaminants of Concern For Operable Unit 300-FF-1

	gross alpha	arochlor 1248
	gross beta	
	gamma scan	trans-1,2-dichloroethylene
	рH	methylene chloride
	·	tetrachloroethylene
	aluminum	trichloroethylene
	antimony	_
	beryllium	uranium-235
	cadmium	uranium-238
•	chromium	
	copper	
	iron	•
	lead	
	manganese	
	mercury	
~ ;	nickel	
C.	silver	
	zinc	
ensity, 13	ammonium	
, ~	fluoride	
***	nitrate	
4,-	nitrite	
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Even though no gamma emitting radionuclides met the criteria for being designated as a contaminant of concern, a gamma scan is added because of the general nature of wastes disposed of within the operable unit. In conjunction with measurements of gross alpha and gross beta, all radiation contamination will be accounted for.

Although total coliforms has exceeded an ARAR in groundwater, it is excluded as a contaminant of concern due to its nonspecificity as an indicator of environmental contamination (Laws, 1981).

3.3.4 Imminent and Substantial Endangerments to Public Health and the Environment

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Based on the extensive amount of environmental data available, including a recent radiation risk assessment for the Hanford Site as a whole (PNL, 1988), the 300-FF-1 operable unit does not appear to pose any imminent or substantial endangerment to public health or the environment. The preliminary toxicity assessment does, however, demonstrate that health and safety monitoring and control procedures, with respect to fugitive dust, are appropriate in the immediate vicinity of the exposed soils of the process trenches and ponds. If interim measures are needed to eliminate the fugitive dust pathway, dust suppressants could be utilized to stabilize these soils until remedial action is undertaken.

Because very limited data suggests that waterfowl having access to the process trenches may be contaminated (Chapter 3.1.6.2), a simple expedited response action to inhibit such access may be advisable. This could consist merely of flagging the trenches to discourage waterfowl from landing on the trench water.

3.4 PRELIMINARY REMEDIAL ACTION OBJECTIVES, PRELIMINARY TECHNOLOGIES, AND ALTERNATIVES

Media-specific remedial action objectives for operable unit 300-FF-1 have been developed based on the preliminary data regarding the contaminants present, the potential exposure pathways, and remediation goals. General response actions have been developed for each medium that will be evaluated and implemented to satisfy the remedial action objectives. Technologies applicable to each general response action have been considered for preliminary screening based on available data. These technologies have been assembled into alternatives for soil, sediment, and groundwater remediation in the 300 Area.

Preliminary remedial alternatives have been developed to address contamination associated with the use of process liquid waste disposal facilities, radioactive liquid waste transfer and storage facilities, burial grounds, and hazardous waste storage facilities. Information regarding historical treatment and disposal activities in the 300 Area has been used to determine possible waste constituents in the soils, sediments, surface water, and groundwater. Additional data will be developed during the RI that may impact the technologies and alternatives that are considered for the operable unit. Groundwater objectives and technologies may be refined in the 300-FF-5 work plan.

3.4.1 Remedial Action Objectives

The contaminants determined to be present and of interest in the operable unit include metals, corrosives, halogenated hydrocarbons, and radionuclides. Additional environmental data gathered during the remedial investigations may expand the list of contaminant types.

Media-specific remedial action objectives and general response actions developed for screening are presented in Table 3-37. The general response actions are developed to provide for human health and environmental protection. The potential media of concern for the operable unit include: soils beneath and near the process liquid disposal and transfer facilities, burial grounds, and radioactive liquid waste transfer and storage facilities; groundwater; surface water and sediment in the Columbia River; air; and biota.

3.4.2 Preliminary Remedial Technologies

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General remedial technologies included for preliminary screening for the 300-FF-1 operable unit are presented in Table 3-38. These technologies address the waste constituents expected to be present in soils, sediments, and groundwater. Applicable technologies will be better defined as additional RI data is obtained.

Although remedial response objectives were developed for surface water, air, and biota, no specific remedial technologies and subsequent remedial alternatives have been identified for these media. If any of these media are determined to be substantially impacted during the RI, the source of this impact would be either the soils, sediments, or groundwater. Therefore, remediation of the latter media would achieve the response objectives for the others.

3.4.3 Preliminary Remedial Alternatives

The preliminary identification of remedial alternatives for soils, sediments, and groundwater are presented in Table 3-39. They include no action with institutional controls, containment, removal/treatment, removal/disposal and in-situ treatment alternatives for soils and sediments and no action containment, collection/treatment and disposal alternatives for groundwater. Several technologies will be considered for each remedial alternative. Various combinations of technologies preliminary listed in Table 3-36 can be used to form an alternative. On-site and off-site treatment and disposal options will be considered for each medium as appropriate. Treated water reuse will also be addressed as an option or in conjunction with discharge to the Columbia River.

Table 3-37. Preliminary Remedial Action Objectives and General Response Actions for Operable Unit 300-FF-1 (Sheet 1 of 3)

ENVIRONMENTAL MEDIUM	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS
Soil	For human health:	No action:
	Prevent ingestion, inhalation, or direct contact with contaminated soils.	No action with institutional actions suas deed restriction for land use.
	For environmental protection: Prevent migration of soil	Additional site access restrictions.
	contaminants that would result in groundwater or surface water contamination.	Long-term monitoring.
River Sediments	For human health:	No_action:
	Prevent ingestion of or direct contact with contaminated sediments in and along the Columbia River, a recreation area.	No action with institutional action suc as deed restriction for land use.
	For environmental protection:	Additional site access restrictions.
	Prevent migration of sediment contaminants that would result in	Long-term monitoring.
	surface water or biota contamination in the Columbia River.	Capping with institution controls.
		Capping with long-term monitoring.
		Excavation/treatment/disposal_actions:
		Excavation/landfill disposal
		Containment actions:
		Capping with institution controls.
		Capping with long-term monitoring.

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Table 3-37. Preliminary Remedial Action Objectives and General Response Actions for Operable Unit 300-FF-1 (Sheet 2 of 3)

ENVIRONMENTAL MEDIUM	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIO
River sediments (continued)		Excavation/treatment/disposal_actions:
		Excavation/landfill disposal.
		Excavation/incinerati ash landfill disposal
Groundwater	For human health:	No action:
	Prevent ingestion of contaminated groundwater.	No action with institutional actions
	For environmental protection:	as deed restrictions alternate drinking wa
·	Prevent adverse environmental impacts resulting from migration of contaminants in groundwater to the Columbia River.	<pre>collection/treatment actions:</pre>
		In situ treatment.
		Pumping (collection)/treatment/reinjection
		Pumping (collection)/treatment/discharge.
Biota	For human health:	No action:
	Prevent ingestion of contaminated biota.	No action with monito
	For environmental protection:	Containment action:
	Prevent adverse environmental impacts on local biota.	Capping of contaminat soil/sediment areas t prevent biota exposur wastes.
,		Containment of contaminated groundwa to prevent migration surface water and subsequent biota expoto contaminated water and/or sediments.

Table 3-37. Preliminary Remedial Action Objectives and General Response Actions for Operable Unit 300-FF-1 (Sheet 3 of 3)

ENVIRONMENTAL MEDIUM	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	
Surface water	For human health:	No action:	
•	Prevent ingestion of and dermal contact with contaminated surface water in and along the Columbia River, a public drinking water source and recreation area. For environmental protection: Ensure that site water discharges do not contaminate the Columbia River.	No action with institutional actions so as deed restrictions on water use and use of alternate drinking water supply and monitoring. Containment action: Groundwater containment via lateral or horizonta barriers to prevent migration to the Columbi River. Pump/treat/reinject/discharge groundwater to prevent migration to the Columbia River.	
Air	For human health:	No action:	
	Prevent inhalation of airborne contaminants, and exposure to radiation shine.	No action with institutional actions so as deed restrictions.	
	•	Containment actions:	
		Cap or cover soils and/osediments to prevent airborne migration and volatilization of constituents.	

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Table 3-38. Preliminary Remedial Technologies for Operable Unit 300-FF-1 Media (Sheet 1 of 3)

ENVIRONMENTAL MEDIA	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGIES	
Soils/sediments	Excavation	Physical removal of waste materials for treatment or disposal	
	Capping	Barrier placed on top of wast	
	Chemical stabilization/ solidification	Process to mix chemical waster with materials (e.g., cement, lime kiln dust, cement kiln dust, fly ash, or proprietary agents) to fix the waste solubility and leachability is a dry aggregate or solid material.	
	Landfill	Waste materials are disposed of in an area designed to receive the wastes. Materials may be drummed or disposed of in bulk form.	
	Incineration	Combustion/oxidation of organ- waste materials at high temperatures.	
	Biodegradation	On-site or in-situ treatment of wastes by enhancing the growth of microbes specially adapted to degradation of PCBs and waste constituents.	
	Dehalogenation (KPEG Process)	Treatment of PCB wastes in which potassium, polyethylene glycol (KPEG) is utilized to dechlorinate the PCB molecule.	
	In situ steam stripping	Removes volatile organic constituents from contaminated soils and waste. Dissolved gases are transferred to air streams. Steam is used as the stripping gas.	

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Table 3-38. Preliminary Remedial Technologies for Operable Unit 300-FF-1 Media (Sheet 2 of 3)

ENVIRONMENTAL MEDIA	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGIES
Soils/sediments (continued)	Vapor extraction	Removes volatile organic constituents from contaminated soils and wastes. Dissolved gases are transferred to air streams.
	Flushing	Use of water and/or surfactant to enhance elutriation of organic or inorganic contaminants from soil. Used in conjunction with other treatment steps.
	Vitrification	Incorporation of waste materials into a glass matrix by the introduction of electric currents
Groundwater	Extraction wells	Groundwater collection wells suitable for deep systems or in shallow groundwater where trenches are not cost effective.
	Subsurface barrier	Underground barriers used to physically divert groundwater flow from an area or to contain a plume.
	Physical/chemical treatment	Represents various oxidation, reduction, ultrafiltration, or pH adjustment methods to effect the removal of soluble metals from water through precipitation.
	Electrocoagulation	Represents treatment with electrical currents causing suspended and dissolved solids to precipitate.
	Air or steam stripping	Removes volatile organic constituents from an aqueous stream. Dissolved gases are emitted as offgas.

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Table 3-38. Preliminary Remedial Technologies for Operable Unit 300-FF-1 Media (Sheet 3 of 3)

ENVIRONMENTAL MEDIA	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGIES
Groundwater (continued)	Adsorption	Adsorption of organic constituents by physical/chemical forces onto activated carbon material or resins.
	Ion exchange	Process to replace inorganics in waste with innocuous inorganics.
	Reverse osmosis	Concentrates inorganic salts and some organics by forcing the solvent through a semipermeable membrane which acts as a filter to remove total dissolved solids.
•	Biodegradation	Represents various biological treatment methods including activated sludge, anaerobic filters, trickling filters, anaerobic lagoons, or stabilization ponds. May include in situ methods.
	Evaporation	Concentration of nonvolatile components in a solution or dilute slurry by vaporization of the solvent (water).

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Table 3-39. Preliminary Remedial Alternatives for Operable Unit 300-FF-1 (sheet 1 of 3)

ENVIRONMENTAL MEDIUM	REMEDIAL ALTERNATIVE	GENERAL RESPONSE ACTIONS
Soils	No action	Deed restrictions for future land use
		Long-term monitoring
		Additional site access restrictions
•	Containment	Capping clay cap, RCRA cap
		Vertical barrier slurry wall
		Horizontal barrier synthetic liners, grout injection
	Removal/treatment	Excavation, stabilization
		Excavation, physical treatment (leaching, etc.)
		Excavation, biological treatment
		Excavation, incineration (onsite of offsite)
	Removal/disposal	Excavation, stabilization/fixa- tion, landfill disposal (onsite or offsite)
		Excavation, landfill disposal (onsite or offsite)
	In situ treatment	Solidification
		Biological
		Air stripping (vapor extraction)
		Steam stripping
		Flushing
		Vitrification

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Table 3-39. Preliminary Remedial Alternatives for Operable Unit 300-FF-1 (sheet 2 of 3)

ENVIRONMENTAL MEDIUM	REMEDIAL ALTERNATIVE	GENERAL RESPONSE ACTIONS
Sediments	No action	Long-term monitoring
		Additional site access restrictions
	Containment	Capping clay cap, RCRA cap
		Surface controls diversion/collection, soil stabilization
	Removal/treatment	Excavation stabilization/ fixation, incineration (onsite and offsite)
		Excavation, physical treatment
	,	Excavation, biological treatment
		Excavation, incineration (onsite or offsite)
	Removal/disposal	Excavation, stabilization/ fixation, landfill disposal (onsite or offsite)
		Excavation, landfill disposal (onsite or offsite)
		Excavation, relocation onsite, cap
Groundwater	No action	Long-term monitoring in conjunction with site groundwater containment
		Water use restrictions
		Alternate water supply
	Collection	Extraction wells

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Table 3-39. Preliminary Remedial Alternatives for Operable Unit 300-FF-1 (sheet 3 of 3)

ENVIRONMENTAL MEDIUM	REMEDIAL ALTERNATIVE	GENERAL RESPONSE ACTIONS
	Treatment	Biological anaerobic, aerobic
		Physical/chemical
		Chemical precipitation
		Ultraviolet radiation
		Electrocoagulation
		Air or steam stripping
		Alkaline hydrolysis
		Activated carbon adsorption
		Ion exchange
•		Reverse osmosis
		Onsite reuse, cooling water
		Offsite discharge into Columbia River
		Water reinjection
		Cap clay and soil, asphalt, concrete, multimedia
	Disposal	Vertical barriers slurry wall grout curtain
		Horizontal barrier grout injection
	Containment	

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4.0 WORK PLAN RATIONALE

The preceding chapters set forth the overall goals and process for the RI/FS, describe the operable unit and its surroundings, and define a conceptual contaminant exposure pathway model for 300-FF-1. The purpose of this chapter is to specify data quality objectives for the RI/FS, and to discuss the approach that will be used to gather and process the information required to satisfy the project goals.

4.1 DATA QUALITY OBJECTIVES

Data quality objectives are specific project data needs:

- o who will use the data;
- o why the data are required;
- o what types of data are needed;
- o how much data are necessary; and
- o how good must the data be?

These needs are specified, to the extent practicable, to provide objectives which will keep the RI/FS focused on project goals. Table 4-1 provides a summary of data quality objectives by environmental medium. The groundwater medium will be addressed in the 300-FF-5 Work Plan.

4.1.1 Data Users

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Data users can be grouped into two general categories: primary and secondary. Primary data users are those individuals directly involved in performing the RI/FS project; they include:

- o DOE, EPA, and Ecology remedial project managers;
- o WHC, EPA, and Ecology unit;
- o the RI and FS coordinators; and
- o the technical contributors.

Secondary data users are those individuals who rely mainly on outputs from the RI/FS to support their activities. Secondary data users also have the opportunity to provide inputs to the primary data users. Inputs may be given during the report review process and through community relations activities. Secondary data users include:

- o the Secretary of DOE;
- o the Regional Administrator of EPA;
- o the Director of Ecology;
- o other federal and state agencies;
- o members of the potentially impacted community;
- o special interest groups; and
- o the general public.

Due to the general nature of this category of data quality objectives, data users are not identified in Table 4-1.

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Table 4-1. Data Quality Objectives Summary for Operable Unit 300-FF-1 (Sheet 1 of 5)

Environmental Medium	Data Uses	Data Types	Data Quantity	Data Quality
Source	site characterization occupational health and safety evaluation of alternatives	facility location operable unit topog	sufficient data exists operable unit topographic map showing facility locations	not applicable third order precision and accuracy; 0.6 m (2 ft)
	design of alternatives monitoring during remedial action	facility integrity	to be developed process and retired	elevational contours; 1:2,400 scale not applicable
ō	actiuii	facility security waste type	radioactive sewers to be assessed sufficient data exists	not applicable
		waste quantity	to be assessed in burial ground #4 and #5 (3 borings in each)	level I
		waste concentration	sufficient data exists, except for burial grounds #4 and #5	levels I and III
			sufficient data exists, except for burial grounds	levels I and III
		waste properties	#4 and #5 to be further assessed in the baseline risk assessment	not applicable c
Geology	site characterization evaluation of alternatives	geological structure	location and structure of paleolevee to be determined	not applicable
	risk assessment design of alternatives monitoring during remedial action	lithology geological unit locations, dimensions, and orientations	sufficient data exists sufficient data exists	not applicable some applicable

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Table 4-1. Data Quality Objectives Summary for Operable Unit 300-FF-1 (Sheet 2 of 5)

Environmental Medium	Data Uses	Data Types	Data Quantity	Data Quality	<i>!</i>
oil	site characterization	soil type	sufficient data exists	not applicable	
5	occupational health and	biological activity	sufficient data exists	not applicable	•
	safety	engineering properties	at each drive sample	not applicable	
	risk assessment evaluation of alternatives	variability	to be determined during evaluation of soil data	not applicable	
	design of alternatives monitoring during remedial action	permeability	one determination per boring per geological unit encountered	not applicable	
		porosity	one determination per boring per geological unit encountered	not applicable	
		moisture content	one determination per boring per geological unit encountered	not applicable	_
		grain size distribution	one determination per boring per geological unit encountered	not applicable	טני-ג
		soil quality	approximately 44 vertical and 6 horizontal borings	levels I and III	RE 88
		leachability	dependent on contaminant distribution results	not applicable	ىل.
	•	absorptability	dependent on contaminant distribution results	not applicable	1 DRAF

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Table 4-1. Data Quality Objectives Summary for Operable Unit 300-FF-1 (Sheet 3 of 5)

Environmental Medium	Data Uses	Data Types	Data Quantity	Data Quality	
NOTE: THE FOLLOWING INFORMAT FOLLOWING, NOW OFFICIALLY ENU THE 300-FF-5 WORK PLAN.	TION, PART OF 300-FF-1 AS ORIGINA COMPASSED WITHIN THE GROUNDWATER,	LLY DEFINED, IS PRESENTED IN PRELI SURFACE WATER AND SEDIMENT, AND A	MINARY FORM AS A COURTESY FOR IN AQUATIC BIOTA OPERABLE UNIT, WILL	ITIAL REGULATORY REVIEW. BE REVISED FOR PRESENTA	. THE ATION I
Groundwater	site characterization evaluation of alternatives	locations and dimensions of hydrostratigraphic units	sufficient data exists	not applicable	
	risk assessment design of alternatives	hydraulic properties of such units	dependent on data compilation results	not applicable	
	monitoring during remedial action occupational health and safety	flow velocities and quantities	continuous static water level measurements at 8 wells; discrete measurements at remaining wells (exact number dependent on data compilation results)	not applicable	
		groundwater quality	quarterly sampling on 7 new wells and an undetermined number of existing wells (exact number dependent on	levels I and III	DOE-RL
		groundwater use	data compilation results) sufficient information exists		88

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Table 4-1. Data Quality Objectives Summary for Operable Unit 300-FF-1 (Sheet 4 of 5)

Environmental Medium	Data Uses	Data Uses Data Types Data Quantity		Data Quality	
NOTE: THE FOLLOWING INFORMAT FOLLOWING, NOW OFFICIALLY ENC THE 300-FF-5 WORK PLAN.	TION, PART OF 300-FF-1 AS ORIGINA COMPASSED WITHIN THE GROUNDWATER,	LLY DEFINED, IS PRESENTED IN PRELI SURFACE WATER AND SEDIMENT, AND A	IMINARY FORM AS A COURTESY FOR IN AQUATIC BIOTA OPERABLE UNIT, WILL	IITIAL REGULATORY REV BE REVISED FOR PRES	IEW. THE SENTATION
Surface Water and Sediment	site characterization risk assessment	drainage patterns	topographic map will provide sufficient information	not applicable	
	evaluation of alternatives design of alternatives	Columbia River morphology and hydraulics	sufficient information exists	not applicable	
	monitoring during remedial action occupational health and safety	groundwater interactions	continuous static water level and water quality screening in 8 wells and two gaging stations; discrete measurements at remaining wells (exact number dependent on groundwater data compilation results)	not applicable	DOE
		surface water use	sufficient data exists	not applicable	늄
Air	site characterization occupational health and safety risk assessment evaluation of alternatives design of alternatives monitoring during remedial	precipitation temperature wind velocity evapotranspiration atmospheric stratification magnitudes and frequencies of extreme weather events	sufficient data exists sufficient data exists sufficient data exists sufficient data exists sufficient data exists sufficient data exists	not applicable not applicable not applicable not applicable not applicable not applicable	. 88-31 DRAF
	action	air quality	existing ambient air monitoring program to be supplemented	level IV	Ä

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Table 4-1. Data Quality Objectives Summary for Operable Unit 300-FF-1 (Sheet 5 of 5)

Environmental Medium	Data Uses	Data Types	Data Quantity	Data Quality
Terrestrial Biota	site characterization risk assessment	potentially impacted fauna and flora	operable unit survey to be performed	not applicable
·	evaluation of alternatives monitoring during remedial	presence of critical habitats of endangered species	operable unit survey to be performed	not applicable
	action	biocontamination.	sufficient data exists	not applicable

4.1.2 Data Uses

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Data generated during the RI generally are put to use in one or more of the following categories:

- o site characterization,
- o occupational health and safety,
- o risk assessment,
- o evaluation of alternatives,
- o design of alternatives, or
- o monitoring during remedial action.

Each of these categories of data uses is discussed below in further detail. Table 4-1 gives an indication of how data gathered on each environmental medium will be applied in the context of these categories.

- 4.1.2.1 Site Characterization. Site characterization refers to the determination and evaluation of the physical and chemical properties of the site, in this case the 300-FF-1 Operable Unit. Characterization also includes the development and refinement of the conceptual contaminant exposure pathway model, and the evaluation of the nature and extent of contamination.
- 4.1.2.2 Occupational Health and Safety. To ensure the health and safety of workers involved in the RI/FS field activities, data are collected on an activity-specific basis. This type of ongoing monitoring data is used—in conjunction with proper safe working practices and utilization of personal protection, as appropriate—to prevent on—site workers from being exposed to harmful amounts of contaminants. This data is also used to determine if there is any immediate concerns for off-site worker and residential populations. The specific data needs for this category, and methods to be used to satisfy them, are addressed in the HASP (Attachment 2).
- 4.1.2.3 Risk Assessment. Data collected to conduct the baseline risk assessment include input parameters for various performance assessment models, site characteristics, and contaminant information required to evaluate the threats to human and environmental receptors posed by releases of hazardous substances from the operable unit. These needs usually overlap with site characterization needs; however, higher quality data is often needed for risk assessment purposes.
- 4.1.2.4 Evaluation of Alternatives. Information used to evaluate remedial alternatives during the FS includes site characteristics and engineering data required for the development, screening, and detailed evaluation of such alternatives. Sufficient information is needed only for feasibility-level designs.
- **4.1.2.5** Design of Alternatives. Once an alternative is selected for implementation, much of the data collected during the RI/FS can be used for the final engineering design. As a specific RI/FS objective, collection of information for use in the detailed, final design is often not cost effective. It is often much more effective to gather such specific information after the record of decision, during a pre-design investigation.

4.1.2.6 Monitoring During Remedial Action. RI/FS data can be used to establish a pre-remediation baseline data set. Environmental monitoring, after implementation of the selected remedial action, can be performed to allow for comparisons with the baseline data to evaluate the effectiveness of the remedial action. RI/FS data can also be consulted to determine the needs and best methods for any post-remediation monitoring that may be needed.

If the selected remedial action has the potential to cause adverse environmental impacts during the construction or operations phases, monitoring will be essential. Obtaining information during the RI/FS to specifically compile a baseline is not, however, an appropriate project objective. Sufficient information will be generated to establish contaminant-specific action levels upon which remedial action monitoring efforts can be focused.

4.1.3 Data Types

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The types of data needed to satisfy the project goals are discussed below by medium. Table 4-1 summarizes the types of data required under each of the following categories.

- **4.1.3.1** Source Data. The types of source data required to perform the FS are (EPA, 1988b):
 - o facility characteristics --

source locations, types of waste containment, integrity of waste containment structures, non-waste related engineered structures, facility security, and discharge points; and

o waste characteristics--

waste types, waste quantities, waste concentrations, and waste properties.

- **4.1.3.2 Geological Data.** Pertinent types of geological data needed for the FS are (EPA, 1988b):
 - o lithology;
 - o geological unit locations, dimensions, and orientations; and
 - o geological structure.
- 4.1.3.3 Soil Data. Soil data types required for the FS include (EPA, 1988b):
 - o soil type;
 - o holding capacity;
 - o biological activity;
 - o engineering properties;
 - o variability;
 - o permeability;

- o porosity;
- o moisture content;
- o grain size distribution;
- o soil quality (including background conditions);
- o leachability; and
- o absorptability.
- 4.1.3.4 Groundwater Data. Data types needed to characterize the groundwater beneath the operable unit will be discussed in the 300-FF-5 Work Plan.

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The types of groundwater data which must be collected are:

- o locations and dimensions of hydrostratigraphic units;
- o hydraulic properties of such units;
- o flow velocities and quantities;
- o interactions with surface water;
- o groundwater quality (including background conditions); and
- o groundwater use.

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This information will be obtained through a program of monitoring existing and additional groundwater monitoring wells.

Physical data will be obtained by sampling soils as new wells are installed and by reviewing existing well logs. The exact location and elevation of each well will be determined to allow for accurate determinations of subsurface unit locations and dimensions. This will also allow for accurate measurements of static water levels in the wells--information needed to determine flow characteristics.

Data relevant to the interactions between the 300-FF-1 groundwaters and the Columbia River at various river stages are to better understand the nature and rate of contaminant transport through groundwater. Information on river and corresponding groundwater levels is needed, along with some general water quality indicators. Other physical data needed are porosity, transmissivity, hydraulic conductivity, storativity, dispersivity, grain size distribution, density, pressure conditions, and locations of sampling points.

As with soil, the contaminants of interest for 300-FF-1 groundwater are known. Additional contaminant data is needed to determine the extent of the impacts to this medium. The RI groundwater investigation should focus on the analysis of filtered parameters, as appropriate. This is especially the case for metals which are primary parameters of interest. Total metal analyses are not appropriate for characterizing groundwater quality, as particulates are not transported under normal groundwater flow conditions. Sufficient wells are currently available to characterize background conditions, but additional sampling of these wells is necessary.

Groundwater use in the immediate vicinity of 300-FF-1 must be further evaluated.

4.1.3.5 Surface Water and Sediment Data. Data types needed to characterize the surface water and sediments of the Columbia River in the vicinity of the 300 Area will be discussed in the 300-FF-5 Work Plan.

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Surface water and sediment data types required for the FS are (EPA, 1988b):

- o drainage patterns:
- o Columbia River morphology and hydraulics;
- o groundwater interactions;
- o water and sediment quality (including background conditions); and
- o surface water use.
- **4.1.3.6** Air Data. The types of atmospheric data needed to perform the FS are (EPA, 1988b):
 - o precipitation;
 - o temperature;

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- o wind velocity;
- o evapotranspiration;
- o atmospheric stratification;
- o magnitudes and frequencies of extreme weather events: and
- o air quality (including background conditions).
- 4.1.3.7 Biological Data. The types of biological and ecological data required for the FS are (EPA, 1988b):
 - o potentially impacted flora and fauna;
 - o presence of critical habitats;
 - o biocontamination (including background conditions);
 - o land use characteristics; and
 - o water use characteristics.

4.1.4 Data Quantity

The following is a conceptual discussion of the quantities of data that must be obtained during the initial phase of the 300-FF-1 RI. By evaluating data as they become available, phasing the RI/FS, and providing for close interaction between the RI and FS coordinators, data quantity adequacy can be continually assessed, and the scope of the initial phase of the RI altered as required.

If additional data needs are identified late in the first RI phase, additional characterization activities can be scheduled during the treatability investigation. The RI is terminated only when a sufficient amount of information is available to allow for the completion of the FS.

4.1.4.1 Source Data. Much information on facility and waste characteristics for 300-FF-1 are already available. At this point, only selected 300-FF-1 waste transfer, storage, and disposal facilities are targeted for direct characterization during the RI. Several of the facilities handled only non-hazardous wastes, some have had no documented releases of hazardous substances, and certain facilities can be effectively combined to focus the investigation. Table 4-2 indicates which of the operable unit facilities, or combination of facilities, will be the focus of the 300-FF-1 RI/FS. Facilities that will not be directly characterized are also indicated, along with a rationale for this decision. The groundwater investigation, conducted under 300-FF-5, will provide for at least an indirect characterization of all 300 Area facilities.

A general search for and evaluation of any existing facility plans and operations reports will be undertaken to hopefully obtain as much information as possible to avoid unnecessary field data collection activities. A series of meetings and site visits with current and past 300 Area employees, familiar with past operations, will also be conducted to assess the completeness of the current understanding of the operable unit.

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Source locations for 300-FF-1 facilities are generally well known. Refinements on all locations are needed, but this is especially true in regard to the buried process and retired radioactive sewer pipelines. The depths of the fill in burial grounds #4 and #5 also need to be determined. Information regarding the specific location of the spill of phosphoric acid at the 340 complex also needs to be found and evaluated to determine if specific activities need to be undertaken to characterize this release. Facility locations will be documented by mapping the operable unit--something which will also have to be done for all sampling locations established during the RI. A topographic baseline map of the operable unit, with 0.6 m (2 ft) elevational contours, 1:2,400 scale, and third order accuracy and precision, needs to be developed. Locations of buried pipelines need to be determined, by geophysical method if appropriate facility plans are not found, over their entire routes which lie within the operable unit boundaries. The depth--and perhaps the content, to some extent--of the burial grounds will also be determined by geophysical techniques performed over a relatively tight grid pattern 7.6 m (25 ft).

Types of waste containment facilities present within the operable unit are well known. Because the major facilities (the south and north process ponds, the 307 trenches, and the process trenches) were designed and operated as soil column disposal facilities for process sewage, their integrities are not in question (i.e., contamination is known to have reached the groundwater). There are no data to suggest that there have been releases of contaminants from burial grounds #4 and #5, but this will have to be assessed by sampling the underlying soils. The process sewer pipelines are suspected of leaking; therefore, locations of major leaks will be determined through geophysical methods. It is also possible that the retired radioactive sewer pipelines could have leaked. Due to the stainless steel construction of this system, a soil tracer gas survey will be conducted to locate points of leakage. The 307 retention basins have the potential to have leaked. This potential will be assessed by sampling soil columns adjacent to the basins so that their operations will not be impacted.

Table 4-2. Facilities in Operable Unit 300-FF-1 Which Do and Do Not Require Further Investigation During the RI/FS

Facilities Targeted for Further Investigation

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c) C Process Sewer System
South Process Pond (including the Retired Filter Backwash Pond)
North Process Pond (including the North Process Pond Scraping Disposal Area)
307 Trenches
Process Trenches
307 Retention Basins
Burial Ground #4
Burial Ground #5
Retired Radioactive Sewer System
340 Complex

Facilities Not Requiring Further Investigation (Plus Rationale)

Sanitary Sewer System (non-hazardous waste facility)
Ash Pits (non-hazardous waste facility)
Filter Backwash Pond (non-hazardous waste facility)
Radioactive Sewer System (leak detection system in place)
340 Complex Hazardous Waste Staging Area (no documented releases)
332 Hazardous Waste Staging Area (no documented releases)

Information available on non-waste related engineered structures, facility security, and discharge points for the 300-FF-1 Operable Unit is sufficient and adequate for purposes of the FS.

Much information on waste characteristics associated with operable unit facilities and operations is already known, except for burial grounds #4 and #5. Information on the nature of the contaminants in these landfills is limited to knowing only that some uranium contaminated materials are present. Therefore, characterization of the sources of contamination in these burial ground is necessary, even though existing data does not indicate any releases from either of these facilities. Sampling of fill material will be performed in conjunction with the sampling of the underlying soils, as mentioned above. Due to the lack of information regarding what was disposed in these burial grounds, analyses for a spectrum of contaminants broader than the contaminants of concern for the operable unit is indicated. Required information on properties of all significant operable unit wastes will be compiled in a baseline risk assessment task during the RI.

4.1.4.2 Geological Data. The geology of the 300-FF-1 Operable Unit is generally sufficiently well known to allow the FS to proceed. Many geological data needs overlap with needs for the soil and groundwater media. Additional geological data will be obtained while collecting soil data during this project and while collecting groundwater data during the 300-FF-5 RI. Such data will be evaluated and incorporated into the project to allow the current understanding of the operable unit geology to be refined.

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More recent geological literature may be available to refine the conceptual model. Therefore, a literature survey for the 300 Area geology will be conducted.

The location of the middle Ringold paleolevee along the Columbia River needs to be further delineated. This lower conductivity paleolevee appears to have a significant degree of control over groundwater flow directions beneath the operable unit. A geophysical survey will be conducted on a 30 m (100 ft) grid above the approximate location of this geological feature to further define its structure.

4.1.4.3 Soil Data. Information on soil types, holding capacity, and biological activities—or sufficient estimations of these parameters—can be obtained from existing Hanford Site literature on descriptive soil studies.

Engineering and physical data will be obtained from existing borehole and well logs, and from the installation of new boreholes during this project and from the installation of new groundwater monitoring wells during implementation of 300-FF-5. Engineering data (soil density) will be obtained on new borehole and well installations. A discrete sample for the analysis of physical parameters (permeability, porosity, moisture content, and grain size distribution) needs to be obtained at a frequency of one sample per borehole location, at a depth determined by random allocation, in each geological stratum encountered. Only the Hanford formation and the upper portion of the middle Ringold are expected to be encountered during drilling to obtain soil samples for 300-FF-1. One sample per geologic stratum per borehole will provide sufficient information to physically characterize each stratum beneath the operable unit.

Due to the nature of facility types and operations, the flat ground surface at the operable unit, the porous nature of the soils, and existing soil quality data, soil contamination is expected to be confined to areas directly underneath or adjacent to the waste containment, transfer, or disposal structures, except, perhaps, for the south and north process ponds. The failure of south pond berm, resulting in an overland flow event to the Columbia River, is a release event which could have extended the limits of soil contamination. Also, both ponds were periodically dredged, and dredged materials were placed on top of the berms. Such contaminated materials could have been dispersed by surface water runoff. Because radionuclides are a major group of contaminants associated with the process sewage, the areal extent of such potential surface contamination can be determined with a surface radiation survey. A surface radiation survey will be conducted around the perimeters of the south and north ponds to detect any contamination outside of the pond basins due to past dredging activities. This survey will be extended out to the east of the south pond. Transects will be spaced no further than 7.6 m (25 ft) apart. This will detect any contamination outside of the pond that is still present from the 1948 berm failure.

Once the horizontal extent of soil contamination is defined, the vertical extent of such contamination needs to be determined at each waste facility and any other areas found to be contaminated. Previous soils studies within and near the operable unit waste facilities have indicated that contamination generally decreases with depth. In most cases, however, a definitive lower boundary of each significantly contaminated zone has not been determined. Limited information is also available to suggest that contamination is attenuated horizontally rather rapidly. Soil sampling boreholes will be installed within and near waste facilities and in background locations to satisfy these needs.

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The nature of soil contamination must be determined below burial grounds #4 and #5, and be verified in the soils associated with the other targeted facilities. Information on the vertical extent of soil contamination is needed for all targeted facilities to assess the need for, and potential degree of, partial removals of contaminated materials. Because it is assumed that each disposal basin (pond, trench, or distinct subpart thereof) will be remediated as a whole, rather than in portions, the numbers of boreholes proposed for each basin is limited to that necessary to provide an average characterization of the extent of contamination with depth. Depending on the size of the basin, one, two, or three borings should be sufficient. If the process sewer is leaking, or if leaks are found in the retired radioactive sewer, characterization of the soils near the leaks will be conducted through borehole sampling. It is assumed that five such boreholes will be needed, and that an additional three will be required to followup the surface radiation survey around the south and north process ponds.

Accurate characterization of background conditions is critical for determining what is and is not contaminated. The existing background data is limited in terms of areal coverage and number of samples. Therefore, sufficient background information from four relatively undisturbed locations within the operable unit will be gathered to allow for meaningful comparisons. This will generate approximately 40 background data points which will provide for an adequate statistical description of conditions. Such samples will be of use, not only for this RI/FS, but for the subsequent investigations and

studies that will be conducted for the two remaining 300 Area source operable units.

At each soil station, visual sampling and on-site field screening (for radiation and volatile organics) need to be performed continuously with depth. Discrete samples for contaminant analysis need to be obtained at various depth intervals, depending on the nature of the facility. Because of the hypothesis of rapid vertical attenuation, the sampling interval with depth, for laboratory analysis of contaminant parameters, should be short within the upper portion of each borehole. In general, continuous sampling (0.5 m or 1.5 ft intervals) through the first 1.8 m (6.0 ft) immediately below the facility, and samples obtained at 1.5 m (5.0 ft) intervals thereafter--to a point approximately 3 m (10 ft) below the water table--should provide the required detail. Sampling intervals will be appropriately adjusted for facilities, such as the burial grounds in the 307 trenches, that contain fill material. In addition to this minimum sampling frequency, discrete samples are required at any changes in lithology and within any zones of apparent contamination that are encountered. Samples of source materials within burial grounds #4 and #5 will be obtained from the soil sampling stations established within these particular facilities.

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Limited information on horizontal contaminant extent is required to verify the hypothesis of no significant lateral contaminant migration within the operable unit soils. Six horizontal boreholes to 0.9 m (3 ft), with samples at 0.3 m (1 ft) intervals (to be extended outward if level I screening, see Chapter 4.1.5, indicates that significant contamination still exists), are proposed for the process trenches. In addition, vertical soil borings will be placed adjacent to the 307 retention basins to determine if they have ever leaked. These borings are being placed outside of the actual basins so that operations are not disturbed. These borings will also provide information pertaining to lateral contaminant extent. The data obtained from these two facilities will be regarded as analogous for the remaining 300-FF-1 process liquid facilities in regard to lateral contaminant extent within the vadose zone.

Leachability and absorptability testing on the operable unit soils may be required, depending on the vertical distribution of contaminants in the soil column. Duplicate archive samples will be retained, whenever a discrete contaminant sample is obtained, to provide representative material for such testing if it becomes apparent that it is necessary.

4.1.4.4 Groundwater Data. These data will be gathered during the 300-FF-5 RI.

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As there is additional groundwater information available from wells near the 300-FF-1 operable unit, an early hydrogeological data compilation task will be performed to obtain this information and, if necessary, refine the groundwater investigation. The completions and chemistry of all wells within the vicinity of 300-FF-1 will be evaluated to determine which are to be

incorporated into the operable unit groundwater investigation, either as background or impact characterization wells.

More information is needed on the physical characteristics of the aquifers in order to understand groundwater flow rates and interactions with the Columbia River. Ten continuous monitoring points will be established to provide this information. These points will consist of two river gaging stations, six shallow groundwater wells, and two intermediate groundwater wells. Each new monitoring well installed will undergo an aquifer test to gather additional physical data, and, as discussed under soil data in Chapter 4.1.5.3, soil samples will be obtained at a frequency of one sample, randomly allocated with respect to depth, in each geologic stratum encountered per installation.

Studies have shown that there are two primary contaminant plumes within the shallow groundwater zone of the operable unit--one emanating from the process trenches, and the other originating from the area near the 340 complex at the south end of 300-FF-1. Further work is needed to pinpoint the exact source of the southern plume, and to further delineate the extent of the northern plume.

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Information shows that the shallow groundwater zone is by far the most impacted, and that the nature of contamination changes with depth. Further groundwater quality studies are needed to complete the characterization of the shallow and intermediate groundwater zones. Three additional shallow wells, and four additional intermediate wells, will be installed. These wells, along with existing wells in the vicinity, will be sampled quarterly for 300-FF-1 contaminants of concern.

A sufficient number of wells are located upgradient of the operable unit to allow for the characterization of background conditions in the three uppermost groundwater zones. These wells will also be sampled quarterly for operable unit contaminants of concern.

Further information on use of groundwater in the immediate vicinity of the operable unit is needed.

4.1.4.5 Surface Water and Sediment Data. These data will be gathered during the 300-FF-5 RI.

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Because the Columbia River is the only major water body associated with the operable unit, creating an operable unit topographic map will provide the necessary information regarding surface drainage patterns at and near 300-FF-1.

Data on river hydraulics are available from 300 Area gauging stations, upstream dam operators, and the U.S. Geological Survey. Information regarding seasonal and diurnal river stage and discharge fluctuations is needed to refine surface water and sediment sampling schedules for determining the

nature and extent of contamination in bank seepage, the river water column, and river sediments. Such sampling will be easier to perform, and will result in the characterization of worst case conditions (maximum relative groundwater input to the river), when undertaken during low river stages. Sufficient information should allow the characterization of the quantities and frequencies of extreme flow events. Information on the structure of the Columbia River channel will be obtained during the surface water sampling. Such information is needed to understand contaminant distributions within the river.

River hydraulics data will be used to further define interactions between surface water and groundwater. For logistical reasons (much of the data needed to perform such a characterization will have to be obtained from groundwater monitoring wells), it is appropriate to defer the bulk of the groundwater/surface water interaction investigation to the 300-FF-5 RI. The river hydraulics data, and evaluations of these data, obtained during this project will be made available to the 300-FF-5 project staff.

The nature and extent of contamination of the water column of the Columbia River needs to be characterized. Contaminated plumes of groundwater are known to be entering the river. Due to the complex interaction of the three 300 Area source operable units and underlying groundwater, it is unlikely that the surface water investigation will be able to pinpoint the exact sources of any surface water problems encountered. This investigation, therefore, will serve as the overall study of 300 Area impacts, as a whole, on the river.

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In an attempt to isolate contaminant inputs, broad spectrum water quality sampling at seeps along the bank of the river, adjacent to the 300 Area, will be performed. Relative flow volumes from each seep will also be estimated to see if groundwater discharge is concentrated at any point along the bank.

Prior to conducting an intensive three dimensional characterization of contaminant distributions in the river, a near shore screening investigation will be performed at low river stage. Broad spectrum water quality and sediment quality samples will be obtained from the river, along the bank, at 305 m (1,000 ft) intervals along and below the 300 Area. Background samples above the 300 Area will also be obtained. The results of this activity will indicate the presence of any contamination in the river or sediments, and if any contamination is present, the actual contaminants of concern for these media will be determined. Also, an approximation of the length of any such plume within the river will be available.

Once information regarding the nature and extent of any plume in the river is obtained, a surface water transect sampling and analysis task will be undertaken to define the length, breadth, and depth of the plume within the water column at low river stage. Sampling transects across the river will be established at 610 m (2,000 ft) intervals along and below the 300 Area for this purpose. A background transect, located above the 300 Area, will also be established to provide data for meaningful comparisons. Due to the armored nature of the substrate within the Columbia River, transect sediment sampling is regarded as unfeasible and, therefore, will not be performed. Data on channel morphology along the 300 Area will be obtained by recording transect widths and water depths at the various sampling locations.

Local uses of the Columbia River are well documented. Because the Columbia River serves as the source of drinking water for the 300 Area and the City of Richland, the quality of the treated drinking waters must be characterized with respect to contaminants known to be contributed to the river by the 300 Area. A review of existing information on the quality of these drinking water will be conducted first to see if it is sufficient prior to initiating new sampling and analysis activities. Also, an additional survey of nearby surface water usage will be performed to confirm the validity of the existing knowledge.

4.1.4.6 Air Data. Climatological data are available from the Hanford Meteorological Station, the wind tower at the 300 Area, and nearby weather stations at the Pasco and Richland airports. These data will be compiled to allow for an up-to-date climatic summary for the 300 Area. The summary will provide 30 year climatic averages (from those stations where sufficient data exists) and frequencies of extreme climatic events.

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Due to the potential for fugitive dust emissions, air is a potential pathway of concern in the immediate vicinity of the south and north process ponds and the process trenches (when one is dry). However, extensive air monitoring for the Hanford Site as a whole, and the 300 Area in particular, has demonstrated this pathway to be insignificant, under current operating conditions, with respect to off-site radiological impacts. Thus, it is highly unlikely that the 300-FF-I Operable Unit, which is a small portion of the entire Hanford Site, can significantly impact off-site populations.

Therefore, a limited ambient air investigation will be conducted in conjunction with the ongoing ambient air monitoring program for the 300 Area. The current program will be assessed, and contaminants of concern for 300-FF-1 will be added to the monitoring schedule as appropriate. Because the current list of parameters is primarily confined to radionuclides, the addition of some of the more toxic and prevalent metals and organics (e.g., chromium and PCBs) is needed. This investigation will test whether or not the hypothesis of an insignificant air exposure pathway is correct.

Because there is a potential for on-site occupational exposure to fugitive dust, while conducting response activities in the immediate vicinity of the process ponds and trenches, health and safety monitoring and personnel protection procedures are appropriate. These procedures are noted in the HASP (Attachment 2).

If either monitoring program demonstrates an unacceptable level of fugitive dust emissions from the process ponds or trenches, dust suppressants could provide interim control until the final remedy is implemented.

- **4.1.4.7 Biological Data.** Because of the nature of the division between 300-FF-1 and 300-FF-5 Operable Units, the 300 Area biology is divided into the terrestrial and aquatic realms.
- 4.1.4.7.1 Terrestrial Biological Data. No significant biological receptors are known to inhabit or use the 300-FF-I ground surface habitat. This, however, needs to be confirmed. Species presence and use of this habitat need to be determined qualitatively, by means of a literature search and on-site biological survey. This effort should be limited to those species

which are endangered, threatened, economically important, or a significant component of the human food chain.

EPA (1987b) has already determined the absence of critical habitat in the 300 Area vicinity. Confirmation of species presence and use of the 300-FF-1 Operable Unit habitat will confirm or deny this determination.

Terrestrial vegetation within the 300 Area has generally higher radionuclide levels than does off-site vegetation. Limited data suggest that waterfowl which visit the process trenches contain elevated levels of radionuclides. No route of exposure from on-site vegetation to the human food chain is likely, and the contaminant transport pathway via waterfowl, while undoubtedly minor, can be easily eliminated by deterring their use of the process trenches by flagging or other similar means. Therefore, a terrestrial biological investigation, beyond the scope of a qualitative literature search and on-site survey, is not necessary.

Sufficient information exists on the restricted nature of land use in the vicinity of the operable unit.

4.1.4.7.2 Aquatic Biological Data. These data, including surface water use characteristics, will be gathered during the 300-FF-5 RI.

4.1.5 Data Quality

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EPA has devised a classification of analytical levels for contaminant data. The classification provides for data of better quality as the scale increases (EPA, 1987a). Level I consists of field screening methods; II entails more advanced on-site analytical techniques; III, standard laboratory procedures; IV, EPA contract laboratory program (CLP) procedures; and V, specially developed procedures to provide a high degree of analytical sensitivity.

As data quality goes up on this scale, costs and turnaround times also increase substantially. Table 4-3 provides a further definition of these analytical levels.

Table 4-1 indicates which analytical levels will be used to obtain data of an acceptable quality for the RI/FS. All laboratory analyses will be performed by a laboratory capable of generating results of a suitable quality for this project. Any samples containing radioactivity in excess of 200 counts/min will be analyzed in a suitable, qualified, on-site laboratory to prevent such material from leaving the Hanford Site.

4.2 WORK PLAN APPROACH

How data will be collected and analyzed is now discussed in general terms to provide an overview of the types of activities needed for the project. These activities are set forth in detail in Chapter 5, and further detail is provided in the FSP (Attachment 1-1). RI/FS tasks will be conducted in a phased manner to optimize project efficiency.

Table 4-3. Analytical Levels

Level	Description		
Level I	Field screening or analysis using portable instruments. Results are often not compound specific and not quantitative, but they are available in real time. This is the least costly of the analytical options. Instruments may not respond to all compounds and may not be able to identify compounds. If the instruments are calibrated properly and data are interpreted correctly, level I techniques can provide an indication of contamination.		
Level II	Field analyses using more sophisticated portable analytical procedures such as gas chromatography (GC) for organics and atomic absorption (AA) or x-ray fluorescence (XRF) for metals. The instruments may be set up in a mobile laboratory on-site. Results are available in real time or within several hours and may provide tentative identification of compounds or be analyte specific. Data are typically reported in concentration ranges, and detection limits may vary from low parts per million (p/m) to low parts per billion (p/b) . Data quality depends on the use of suitable calibration standards, reference materials, sample-handling procedures, and on the training of the operator. In general, level II techniques and instruments are mostly limited to volatiles and metals.		
Level III	All analyses performed at an off-site analytical laboratory. level III analyses may or may not use contract laboratory program (CLP) procedures but do not usually use the validation or documentation procedures required of CLP level IV analysis. Detection limits and data quality are similar to Level IV, but results will generally be available in a shorter time.		
Level IV	Contract laboratory program routine analytical services (RAS). All analyses are performed in an off-site CLP analytical laboratory followed CLP protocols. Generally low p/b detection limit for substances on the Hazardous Substance List (HSL) but may also provide identification of non-HSL compounds. Sample results may take several days to several weeks, and additional time may be required for data validation. Level IV results have known data quality supported by rigorous quality-assurance and quality control protocols and documentation.		
Level V	Analysis by nonstandard methods. All analyses are performed in an offsite analytical laboratory that may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits, and additional lead time may be required. Detection limit and data quality are method specific. The CLP special analytical services (SAS) are level V.		

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4.2.1 Investigation Methodologies

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The initial phase of the RI will include the following, integrated, subcomponent investigational tasks:

- o a source investigation;
- o a soil investigation;
- o an air investigation; and
- o a terrestrial biological investigation.

Each of the interrelated Phase I RI tasks and subtasks is briefly outlined below. Table 4-4 summarizes the activities that will occur during this phase. Specific Phase II RI activities will be determined later on in the project. These needs, which could include either additional operable unit characterization activities, will be spelled out in either, or both, the Phase I and II FS reports.

4.2.1.1 Source Investigation. Subtasks to be performed during the source investigation include:

- o source data compilation to determine, more precisely, the locations of the process and retired radioactive sewers and to uncover additional information regarding the phosphoric acid spill at the 340 complex; a general search for any other engineering plans and environmental reports related to the operable unit, which were not included in the scoping effort to date, will also be conducted; in addition, this subtask will include a series of meetings and onsite visits with current and past personnel having knowledge of former site operations;
- o a ground penetrating radar survey of burial grounds #4 and #5, to determine the depths and gross nature of the fill materials;
- o an electromagnetic survey of the process sewer pipelines (and along the retired radioactive sewer, if necessary) to locate leaks in the sewer system (and to precisely locate the retired radioactive sewer);
- o the preparation of an operable unit topographic base map to precisely define the locations of sources and, subsequently, sampling stations; and
- o a soil tracer gas survey along the retired radioactive sewer pipelines, to locate potential leaks within the system.

Source sampling and analysis within burial grounds #4 and #5 is also required; for logistical reasons, this activity will be performed under the soil investigation.

- **4.2.1.2 Geological Investigation.** The 300-FF-1 Operable Unit geological investigation will consist of two subtasks:
 - o a compilation of the most recent information on the geology of the 300 Area; and

Table 4-4. Phase I Remedial Investigation Field Tasks for the 300-FF-1 Operable Unit (Sheet 1 of 2)

Source	Inves	tig	ation
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- Ground penetrating radar survey--at burial grounds #4 and #5 on a 7.6 m (25 ft) grid.
- Electromagnetic survey--along the entire process and retired radioactive sewer pipeline routes within the operable unit.
- Topographic base map development--encompassing the entire operable unit and all groundwater wells outside of the operable unit which are included in the project.
- Soil tracer gas survey--along the entire length of the retired radioactive sewer pipeline, within the operable unit, at 9 m (30 ft) intervals.

Geological Investigation

Electromagnetic survey--along the Columbia River to define the location and structure of the paleolevee.

Soil Investigation

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- Surface radiation survey--around the perimeters of the south and north process ponds, and over the area between the south process pond and the Columbia River, along transects spaced no greater than 7.6 m (25 ft) apart; also, at a minimum of 30 discrete locations on a grid within a background plot.
- Soil sampling and analysis--44 vertical and 6 horizontal borings (continuous radiation and volatile and ionizable organic screening, and approximately 500 discrete downhole sample locations).

Table 4-4. Phase I Remedial Investigation Field Tasks for the 300-FF-1 Operable Unit (Sheet 1 of 2)

NOTE: THE FOLLOWING INFORMATION, PART OF 300-FF-1 AS ORIGINALLY DEFINED, IS PRESENTED IN PRELIMINARY FORM AS A COURTESY FOR INITIAL REGULATORY REVIEW. THE FOLLOWING, NOW OFFICIALLY ENCOMPASSED WITHIN THE GROUNDWATER, SURFACE WATER AND SEDIMENT, AND AQUATIC BIOTA OPERABLE UNIT, WILL BE REVISED FOR PRESENTATION IN THE 300-FF-5 WORK PLAN.

Groundwater Investigation

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- Monitoring well and gaging station installation--2 river gaging stations and 7 groundwater monitoring wells (3 completed in the shallow zone; 4 completed in the intermediate zone); 130 downhole soil sample locations.
- Groundwater sampling and analysis—all new wells plus a number of existing wells, to be determined, sampled quarterly for one year; a total of 240 discrete samples is assumed.
- Groundwater/surface water interactions--continuous water level and water quality field parameter monitoring for a year in 8 groundwater monitoring wells and 2 river gaging stations.

NOTE: THE FOLLOWING INFORMATION, PART OF 300-FF-1 AS ORIGINALLY DEFINED, IS PRESENTED IN PRELIMINARY FORM AS A COURTESY FOR INITIAL REGULATORY REVIEW. THE FOLLOWING, NOW OFFICIALLY ENCOMPASSED WITHIN THE GROUNDWATER, SURFACE WATER AND SEDIMENT, AND AQUATIC BIOTA OPERABLE UNIT, WILL BE REVISED FOR PRESENTATION IN THE 300-FF-5 WORK PLAN.

Surface Water and Sediment Investigation

- River bank survey--along the entire bank within the boundaries of the operable unit; 5 sample stations assumed.
- Surface water and sediment sampling and analysis--one time each at 9 near-shore sample locations and, if necessary, 5 cross-river transects.
- Drinking water sampling and analysis--one time each at a tap near the City of Richland and 300 Areas water treatment plants (2 discrete sample locations).

Air Investigation

Ambient air sampling and analysis--to be determined (quarterly sampling at 3 stations for one year assumed).

Terrestrial Biological Investigation

Biological survey--over the entire operable unit surface.

o an EM survey to further define the location and structure of the lower conductivity paleochannel along the Columbia River.

Other geological information will be gathered under the soil investigation, and the 300-FF-5 groundwater investigation.

4.2.1.3 Soil Investigation. The 300-FF-1 soil investigation will consist of two subtasks:

- o a surface radiation survey conducted around the south and north process ponds and in the area between the south process pond and the Columbia River, to determine if soil contamination has spread beyond the boundaries of these facilities; surface radiation surveys will also be conducted over burial grounds #4 and #5; and
- o borehole sampling, and subsequent soil analysis, to determine the nature and extent of contamination and the physical characteristics of the vadose zone.

Where possible, the latter subtask will be combined with groundwater monitoring well installations under 300-FF-5 to reduce drilling costs.

The sampling design will provide for a phased investigative approach to maximize the efficient use of resources. Samples will be screened in the field for radiological and volatile organic parameters (level I analysis) to help identify zones of higher contamination between specified discrete sampling intervals, thus allowing a more focused use of laboratory analytical resources.

NOTE: THE FOLLOWING INFORMATION, PART OF 300-FF-1 AS ORIGINALLY DEFINED, IS PRESENTED IN PRELIMINARY FORM AS A COURTESY FOR INITIAL REGULATORY REVIEW. THE FOLLOWING, NOW OFFICIALLY ENCOMPASSED WITHIN THE GROUNDWATER, SURFACE WATER AND SEDIMENT, AND AQUATIC BIOTA OPERABLE UNIT, WILL BE REVISED FOR PRESENTATION IN THE 300-FF-5 WORK PLAN.

- **4.2.1.X Groundwater Investigation.** Groundwater subtasks needed for the RI are:
 - o a compilation of existing hydrogeological data for the 300-FF-1 vicinity;
 - o a further examination of the groundwater/surface water relationship;
 - o the installation of river gaging stations and additional monitoring wells; and
 - o groundwater sampling and analysis.

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As mentioned above, groundwater monitoring well installations will be sited by taking the needs of the soil investigation into consideration, so as to minimize the number of separate independent soil borings needed. The results of the data compilation task will be used to refine the scope of the groundwater investigation, as appropriate.

NOTE: THE FOLLOWING INFORMATION, PART OF 300-FF-1 AS ORIGINALLY DEFINED, IS PRESENTED IN PRELIMINARY FORM AS A COURTESY FOR INITIAL REGULATORY REVIEW. THE FOLLOWING, NOW OFFICIALLY ENCOMPASSED WITHIN THE GROUNDWATER, SURFACE WATER AND SEDIMENT, AND AQUATIC BIOTA OPERABLE UNIT, WILL BE REVISED FOR PRESENTATION IN THE 300-FF-5 WORK PLAN.

- **4.2.1.Y Surface Water and Sediment Investigation.** The surface water and sediment investigation will consist of:
 - o a hydrological data compilation task, to obtain hydraulics information on the Columbia River in the vicinity of the operable unit, to review existing information on the quality of drinking water at the 300 Area and the City of Richland, and to review any existing literature on surface seeps along the river near 300-FF-1;
 - o a river bank seepage survey, to determine locations, relative volumes, and quality of seeps into the Columbia River;
 - o a surface water and sediment sampling and analysis subtask, to determine the nature and extent of contamination in the river; and
 - o a drinking water sampling and analysis task, to assess the quality of drinking water in the 300 Area and the City of Richland.

The information compiled in the initial task will be useful in refining the groundwater/surface water subtask under the groundwater investigation, and may result in a reduction of the scopes, or elimination, of the second and fourth subtasks.

- 4.2.1.4 Air Investigation. The 300-FF-1 air investigation will consist of:
 - o an air data compilation subtask, to compile meteorological data and evaluate the current ambient air monitoring program; and
 - o an ambient air sampling and analysis subtask, to incorporate nonradiological contaminants of concern into the ongoing program.
- **4.2.1.5** Terrestrial Biological Investigation. The biological investigation for the operable unit will consist of a literature search and an on-site, terrestrial biological survey. The purpose of these surveys is to determine the presence within, and use of, the 300-FF-1 habitat by any endangered, threatened, economically important, or significant human food chain component species, and to increase the unit specific understanding of the terrestrial ecosystem structure and function.

4.2.2 Data Evaluation Methodologies

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During the RI, data will be evaluated as soon as they become available. This will allow for the data obtained to be used in rescoping and focusing the RI/FS, as appropriate. The data evaluation task will provide summaries and interpretations of the collected information that will be used to verify contaminant-specific ARARS, develop the baseline risk assessment, perform the FS, and complete the RI report.

Contaminant data for each environmental medium will be plotted so as to facilitate the understanding of the areal or volumetric extent of contamination. Statistical comparisons with background conditions will be performed to determine which contaminants, attributable to the operable unit, are present in elevated concentrations. Several computer models and codes are available at the Hanford Site for the analysis of contaminant transport and environmental exposures. Appendix C provides a list of these models and codes.

Once the list of contaminants of concern for the operable unit is well refined, a task will be undertaken to verify contaminant- and location-specific ARARs for 300-FF-1. Regulatory agency participation in this task will be important.

A separate task for the development of the baseline risk assessment is set forth. This will include the subtasks of contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

The development, screening, and evaluation of remedial alternatives in the FS will be performed using RI data in conjunction with standard costing and technical procedures, knowledge of prior technical applications, and engineering judgement.

4.2.3 Integration of the RI and the FS

The RI and FS will proceed concurrently in an interactive manner. The results of the RI allow for the assessment of alternatives in the FS, and the results of the FS focus and define the data needs for the RI. This process is illustrated in Figure 4-1. The tasks developed for each phase of the project, along with their corresponding subtasks and activities, are discussed in detail in Chapter 5.

4.2.4 Community Relations

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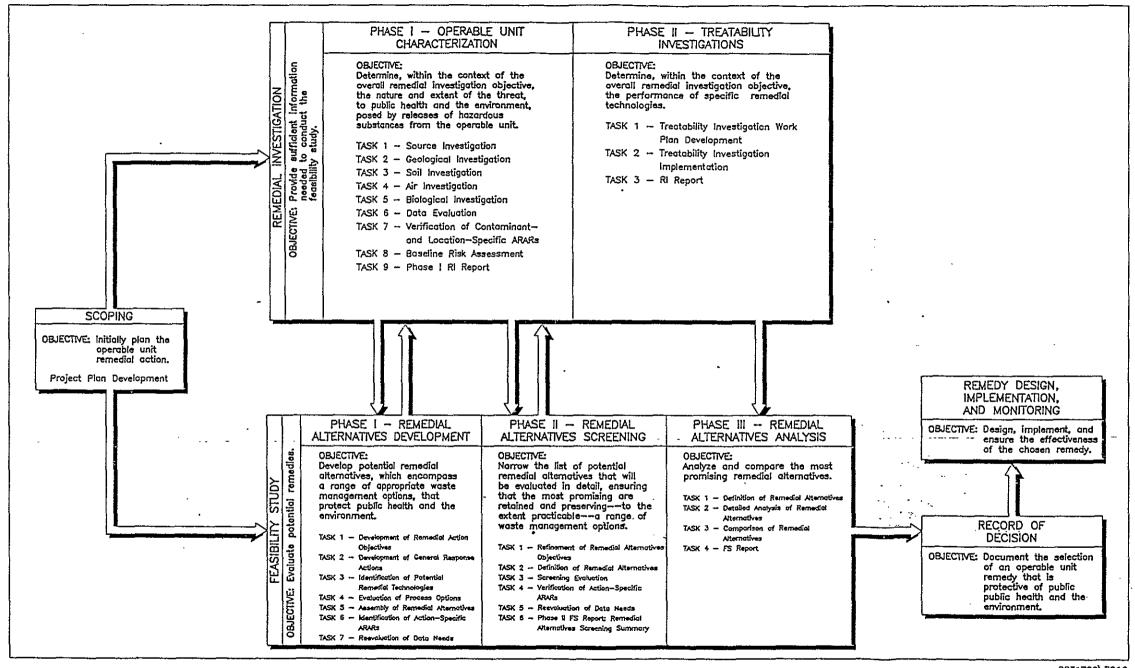
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The community relations program for the operable unit, set forth in the CRP (Attachment 5), will be the formal mechanism for incorporating the concerns of secondary data users. Final RI and FS reports will be made available for formal review and comment. The community relations program will ensure that all comments and concerns received are adequately and appropriately addressed before the selection of a final remedy.



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5.0 RI/FS TASKS

The purpose of this chapter is to set forth the various tasks to be implemented during the course of the project. The specified tasks are designed to provide information to meet the data quality objectives identified in Chapter 4. Detailed information on sampling locations and frequencies and sample designation are presented in the FSP. Equipment and procedures needed to carry out investigation tasks are specified in the QAPP. Environmental monitoring requirements for the purpose of ensuring the health and safety of on-site investigators are set forth in the HASP.

It will be necessary to update this chapter during the course of the project. Depending on the results of certain tasks, others may need to be created, supplemented, or deleted. As such, this portion of the work plan, and the associated attachments, are meant to function as a living document. Revisions will be made and distributed, as appropriate.

5.1 PROJECT MANAGEMENT

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Project management is needed throughout the course of the RI/FS to direct and document project activities and to secure the data and evaluations generated. The initial project management activity will be to assign individuals to roles established in the PMP (Attachment 3). Other tasks which will occur throughout the RI/FS include:

- Task 1 General Management;

- Task 2 Meetings;
 Task 3 Cost Control;
 Task 4 Schedule Control;
- Task 5 Data Management; and
- Task 6 Progress Reports.

Each of these tasks is described below in further detail.

5.1.1 Task 1 - General Management

This task includes the day-to-day supervision of, and communication with. project staff and subcontractors. Throughout the project, daily communications between office and field personnel are required, along with periodic communications with subcontractors, to assess progress and to exchange information.

5.1.2 Task 2 - Meetings

Meetings will be held, as necessary, with members of the project staff, subcontractors, regulatory agencies, and other appropriate entities to communicate information, assess project status, and resolve problems. A kickoff meeting will be held with appropriate project personnel; project staff meetings will be held on a weekly basis. The frequency of other meetings will be determined based upon need.

5.1.3 Task 3 - Cost Control

Project costs will be regularly tracked. Labor, other direct costs (ODCs), and subcontractor expenses will be tracked on a weekly basis. The budget tracking activity will be computerized, and will provide the basis for invoice preparation and review.

5.1.4 Task 4 - Schedule Control

Scheduled milestones will be tracked weekly for each task of each phase of the project.

5.1.5 Task 5 - Data Management

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The project file will be kept organized, secured, and accessible to the appropriate project personnel. All field reports, field logs, health and safety documents, QA/QC documents, laboratory data, memoranda, correspondence, and reports will be logged into the file upon receipt or transmittal. This task is also the mechanism for ensuring that data management procedures, documented in the DMP (Attachment 4) are carried out appropriately.

5.1.6 Task 6 - Progress Reports

Monthly progress reports will be prepared, distributed to the appropriate personnel and entities (project and unit managers, coordinators, contractors, subcontractors, etc.), and entered into the project file. These reports will summarize the work completed, present data generated, and provide evaluations of the data as they become available. Progress, anticipated problems and recommended solutions, upcoming activities, key personnel changes, status of deliverables, and budget and schedule information will be included.

5.2 COMMUNITY RELATIONS

Community relations activities will occur throughout the course of the RI/FS. These activities are specified in the CRP (Attachment 5).

5.3 PHASE I RI - OPERABLE UNIT CHARACTERIZATION

To satisfy the data quality objectives specified in Chapter 4, the following tasks will be performed during the initial phase of the RI:

- Task 1 Source Investigation
- Task 2 Geological Investigation
- Task 3 Soil Investigation
- Task 4 Air Investigation
- Task 5 Biological Investigation
- Task 6 Data Evaluation
- Task 7 Verification of Contaminant- and Location-Specific ARARs
- Task 8 Baseline Risk Assessment

 Task 9 - Phase I RI Report: Preliminary Operable Unit Characterization Summary

Each task, and their component subtasks and activities, are outlined below. Sufficient information is provided on each task to allow for the estimation of the project schedule (see Chapter 6) and costs. Details regarding specific sampling objectives, locations, and frequencies are provided in the FSP (Attachment 1, Part 1). Sampling and analytical procedures are specified in the QAPP (Attachment 1, Part 2).

5.3.1 Task 1 - Source Investigation

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The source investigation for 300-FF-1 is composed of five subtasks:

• Task la - Source Data Compilation;

Task 1b - Ground Penetrating Radar Survey;

Task 1c - Electromagnetic Survey;

• Task 1d - Topographic Base Map Development; and

• Task le - Soil Tracer Gas Survey.

- **5.3.1.1 Task la Source Data Compilation.** The source data compilation subtask will consist of two activities which involve the gathering of additional existing information on 300-FF-1 facilities. The activities under this subtask are:
 - Task la-1 Engineering Plan and Environmental Report Search; and
 - Task la-2 Meetings and Site Visits with Former and Current Site Personnel.

The process and retired radioactive sewers are targeted for further investigation; the 340 complex may not need further attention during the RI, but additional information needs to be evaluated before confirming this decision. The first will hopefully obtain such information, and both activities will verify the results of project scoping to date.

5.3.1.1.1 Task la-1 - Engineering Plan and Environmental Report Search. An attempt will be made to locate additional engineering plans and environmental reports pertinent to 300-FF-1 which have not been reviewed during the scoping process. Any relevant information will be used to refine the operable unit conceptual model and to modify the scope of work as appropriate. Engineering plans will be reviewed specifically to attempt to precisely locate the buried process sewer pipeline, within the operable unit. This information will be used to focus the scope of the subsequent electromagnetic survey over this structure. Engineering plans will also be reviewed specifically to locate the buried, stainless steel retired radioactive sewer lines. If insufficient information is available, an electromagnetic survey will be conducted along this facility to determine its location, so that gas probes or wells can be located effectively during the soil tracer gas survey.

Two releases associated with the 340 complex are known to have occurred. One, in 1954 (UPR-300-2), was mitigated, and another involved a spill of phosphoric acid. No information on the phosphoric acid spill was available

during the development of this work plan; therefore, a search will be conducted to obtain any existing information.

Any information found will be used to develop additional operable unit characterization activities, if necessary. Because phosphoric acid would dissociate upon contact with water in the environment, and phosphate is not a hazardous substance, additional activities are not anticipated.

- 5.3.1.1.2 Task la-2 Meetings and Site Visits with Former and Current Site Personnel. An attempt will be made to identify and locate former and current 300 Area personnel having knowledge of past waste disposal practices. A series of meetings and site visits will be held to obtain further information that may be relevant and useful in refining the operable unit conceptual model. The scope of work for this project may be modified if necessary depending on the information obtained.
- **5.3.1.2 Task 1b Ground Penetrating Radar Survey.** This subtask is divided into two activities:
 - Task 1b-1 Geodetic Survey; and

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• Task 1b-2 - Ground Penetrating Radar Sampling and Analysis.

The scope of this subtask is limited to burial grounds #4 and #5.

- 5.3.1.2.1 Task 1b-1 Geodetic Survey. A grid will be established by geodetic survey over the surfaces of burial grounds #4 and #5. The ground penetrating radar survey will then be conducted along the transects thus established. The grids will be set up at 7.6 m (25 ft) intervals.
- 5.3.1.2.2 Task 1b-2 Ground Penetrating Radar Sampling and Analysis. The ground penetrating radar survey will be conducted along the transects established in Task 1b-1. The results of the survey will be used to determine the depth of fill, location of any burial trenches within the boundaries of each facility, and locations of any buried objects detectable with this technique. Results will be used to help site boreholes to be installed under Task 3b.
- **5.3.1.3 Task 1c Electromagnetic Survey.** The electromagnetic survey consists of three activities, two of which focus on the facilities to be investigated:
 - Task 1c-1 Process Sewer;
 - Task 1c-2 Retired Radioactive Sewer: and
 - Task 1c-3 Geodetic Survey.

The electromagnetic survey will be conducted to screen large areas for possible contamination, or for the purpose of precisely locating the buried structure, in a cost effective manner. Areas identified as having the potential for being contaminated will be demarcated for further investigation.

5.3.1.3.1° Task lc-1 - Process Sewer. An electromagnetic survey will be conducted along the entire length of that portion of the process sewer system which lies within the operable unit boundaries. The purpose of this survey is to determine locations where the pipeline is leaking. At least some of the leaks encountered will be targeted for later soil sampling. If the

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electromagnetic survey is not successful, due to local interferences, an alternative method, such as a television scan, will be considered.

The survey will be conducted along the process sewer using a Geonics Limited EM31. Variations in resistivity may be caused by changes in soil moisture content, presence of ionic species, or the presences of metallic objects. Because the process sewer is constructed of clay pipe and is currently in use, anomalies detected along the pipeline route should be attributable to pipeline leaks. These anomalies will be identified in the field by staking and flagging the locations of occurrence.

The locations of these anomalies will be geodetically surveyed during Task lc-3. If Task la-1 is unsuccessful in precisely locating the process sewer, the path of the structure will be staked and flagged (in a manner different from that used to demarcate potential leaks) to allow the location of the pipeline to be determined during the geodetic survey.

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5.3.1.3.2 Task 1c-2 - Retired Radioactive Sewer. Because the retired radioactive sewer is stainless steel, anomalies due to variations in ground resistivity, which may be present from past leaks, may be masked by the presence of the pipe. Therefore, the purpose of conducting an electromagnetic survey on this facility is to determine the sewer location precisely (within approximately 3 m or 10 ft) for the subsequent soil tracer gas survey. This electromagnetic survey will not be conducted if information is found during the implementation of Task la-2 to locate all portions of this sewer system within the operable unit.

If performed, this survey will be conducted in the same manner as that indicated under Task 1c-1. The location of the pipeline will be staked and flagged for the subsequent geodetic survey.

- 5.3.1.3.3 Task 1c-3 Geodetic Survey. The locations of anomalies found during Task 1c-1, and, if necessary, the locations of the sewer lines as determined during Tasks 1c-1 and 1c-2, will be geodetically surveyed for N-S/E-W coordinates. This information will be used in the preparation of the 300-FF-1 topographic base map (Task 1d).
- 5.3.1.4 Task 1d Topographic Base Map Development. The operable unit map will be prepared to show elevation contours at 0.6 m (2 ft) intervals at a scale of 1:2,400. 300-FF-1 features, such as the operable unit boundary, fence lines, gates, buildings, restricted areas, pipelines, other facilities, and existing sampling locations (e.g., groundwater monitoring wells and air monitoring stations) will be included.

The map will extend at least 100 m (330 ft) beyond the 300-FF-1 boundary. The topographic map will be compatible with the N-S/E-W coordinate system used for the existing operable units maps for the 300 Area. Third order precision and accuracy will be used in developing the map. The map will be periodically updated during the course of the RI/FS to incorporate sampling locations established under other subtasks.

- **5.3.1.5** Task le Soil Tracer Gas Survey. The purpose of this subtask is to detect leaks within the retired radioactive sewer system. The soil tracer gas subtask is, in turn, comprised of four activities:
 - Task le-1 Mobilization;

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- Task le-2 Gas Probe (or Well) Installation;
- Task le-3 Geodetic Survey; and
- Task le-4 Soil Tracer Gas Sampling and Analysis.
- 5.3.1.5.1 Task le-1 Mobilization. Several matters must be handled during the soil tracer gas mobilization activity. First, the feasibility of driving soil gas probes to 3 m (10 ft) depths in the soils of 300-FF-1 must be demonstrated. If this can not be readily accomplished, gas wells will have to be installed along the length of the retired radioactive sewer.

Preparations must be made to pressurize the portions of the pipeline which lie within Operable Unit 300-FF-1. If valves to the system do not exist, valves or packers must be installed. It may be necessary to excavate a portion or portions of the pipeline and install one or more valves or packers to allow for pressurization. A determination as to the limits of pressurization will also be made to prevent any accidental releases of potentially contaminated gas.

Once it is known that the pipeline can be pressurized, coordination with the soil gas subcontractor must occur. If gas wells need to be installed in lieu of driven probes, coordination with a drilling subcontractor must also take place. As a part of the soil gas subcontractor coordination, the selection of a suitable tracer gas must be made. This may involve preliminary testing with the selected subcontractor's equipment.

5.3.1.5.2 Task le-2 - Gas Probe (or Well) Installation. The retired radioactive sewer is located about 3 m (10 ft) below the ground surface. To maximize the sensitivity of the soil tracer gas survey, probes of wells must be installed along the pipeline route as close to the pipeline as possible. If driving probes to the required depth is not feasible (see Task le-1) polyvinyl chloride gas wells will be installed with auger drilling techniques.

Probes, or wells, will be installed at about 9 m (30 ft) intervals along the length of the pipeline. The installations will be made as close to the pipeline, without jeopardizing the its integrity, as possible. This distance will be determined by the quality of location information made available from Task 1a-2 and/or Task 1c-2.

- 5.3.1.5.3 Task le-3 Geodetic Survey. Locations of gas probes or wells, installed under Task le-2, will be surveyed as to location on N-S/E-W coordinates.
- 5.3.1.5.4 Task le-4 Soil Tracer Gas Sampling and Analysis. Once the gas probes or wells are installed, the actual on-site tracer gas sampling and analysis will be performed. Sampling points where tracer gas is encountered will be noted as being locations where radioactive sewage could have leaked from the sewer. These locations will be targeted for further soil characterization.

5.3.2 Task 2 - Geological Investigation

The geological investigation for the operable unit consists of two subtasks--Task 2a - Geological Data Compilation, and Task 2b - Electromagnetic Survey. The first encompasses the collection of existing geological information pertinent to the 300 Area. The second is a geophysical survey to define the structure and location of the upper middle Ringold paleolevee along the Columbia River. Additional geological data will be collected under the soil and 300-FF-5 groundwater investigations during drilling activities.

- **5.3.2.1** Task 2a Geological Data Compilation. A literature review will be conducted under this activity to gather the most recent geological information pertaining to the 300 Area. This information will be used to characterize the geology of 300-FF-1 in the final RI report.
- 5.3.2.2 Task 2b Electromagnetic Survey. An electromagnetic survey along the banks of the Columbia River within the operable unit boundaries will be conducted along a 30 m (100 ft) grid to attempt to further define the location and structure of the paleolevee in the upper middle Ringold deposits. Of considerable interest are the locations of any breaches within this structure. A grid will be surveyed in over the area of interest (Figure 2-7) and the electromagnetic survey will be conducted over this grid.

5.3.3 Task 3 - Soil Investigation

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The 300-FF-1 soil investigation consists of two subtasks:

- Task 3a Surface Radiation Survey; and
- Task 3b Soil Sampling and Analysis.
- 5.3.3.1 Task 3a Surface Radiation Survey. The surface radiation survey for the operable unit is divided into two activities:
 - Task 3a-1 Surface Radiation Sampling and Analysis; and
 - Task 3a-2 Geodetic Survey.

This survey is limited to the areas around the south and north process ponds, to the area east of the south process pond to the Columbia River, and burial grounds #4 and #5.

5.3.3.1.1 Task 3a-1 - Surface Radiation Sampling and Analysis. The ground surface, in the areas around the perimeters of the south and north process ponds and in the area between the south process pond and the Columbia River, will be surveyed for gamma and beta activity. Portable beta/gamma radiation detectors, of the type normally used for such surveys at the Hanford Site, will be employed. An operable unit-specific background plot will first be established by conducting the survey on land surfaces west of the operable unit boundary on a grid established at about 7.6 m (25 ft) intervals.

The ground surface will be surveyed along transects immediately around the perimeter of the north and south process ponds. If radiation levels are statistically elevated (99 percent confidence) at the perimeter of the process ponds, additional transects at a minimum of 7.6 m (25 ft) intervals will be surveyed to determine the extent of elevated radiation. The survey will

continue in this manner until background conditions are encountered. The entire area between the south process pond and the Columbia River will be surveyed for radiation along transects established at intervals of at least 7.6 m (25 ft). The entire surface of burial grounds #4 and #5 will also be surveyed along transects established at intervals of at least 7.6 m (25 ft). Areas with radiation statistically greater than area background will be staked and flagged for the geodetic survey under Task 3a-2 and for more detailed soil inspection under Task 3b-4.

- 5.3.3.1.2 Task 3a-2 Geodetic Survey. Areas where elevated radiation is encountered under Task 3a-1 will be geodetically surveyed to establish the N-S/E-W coordinate locations on the operable unit map.
- 5.3.3.2 Task 3b Soil Sampling and Analysis. The purpose of this subtask is to characterize the type and extent of soil contamination at areas of known and suspected contamination. This characterization is designed to supplement the existing data base in areas that have been partially characterized, provide background soils data for use in the assessment of soil contamination, and provide data in areas of known but uncharacterized contamination.

This subtask is divided into five phases, each of which will be conducted as a separate activity:

- Task 3b-1 Mobilization;
- Task 3b-2 Soil Sampling;

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- Task 3b-3 Soil Sample Analysis;
- Task 3b-4 Geodetic Survey; and
- Task 3b-5 Borehole Abandonment.

The sampling of source materials within burial grounds #4 and #5 is included in the second activity.

5.3.3.2.1 Task 3b-1 - Mobilization. Matters to be addressed in this mobilization activity include an evaluation of drilling and soil sampling methodologies, an evaluation of archeological resources within the operable unit, and coordination with the drilling subcontractor.

Before proceeding with the installation of soil boreholes, existing drilling and soil sampling methodologies, which are approved for use at the Hanford Site, will be evaluated to select the respective methods which are most efficient and effective.

A file and field survey of all proposed drilling sites will be conducted to ensure that no significant archeological resources are disturbed during the implementation of Task 3b.

Coordination with the drilling subcontractor will occur to prepare for the upcoming drilling activities.

5.3.3.2.2 Task 3b-2 - Soil Sampling. Borehole soil sampling will proceed in three parts: characterization of background conditions, characterization of contaminated soils associated with specific 300-FF-1 waste facilities, and characterization of soils potentially contaminated as interpreted from the electromagnetic, soil tracer gas, and surface radiation surveys. All boreholes installed under this activity will be properly

abandoned in accordance with regulatory requirements (Task 3b-5) upon completion of the geodetic survey (Task 3b-4).

<u>Background Soil Characterization</u>. Background levels of total metals have not been sufficiently characterized to assess contamination within soils of the 300-FF-1 operable unit. A total of four borings will be drilled in areas not impacted by operational activities at the 300 Area, to obtain vadose zone samples for soil background analysis.

Three borings will be drilled in the northern vicinity of the operable unit near the process trenches. One additional boring will be drilled in the southern portion of the operable unit to assess spatial variability. Samples will be obtained within all borings at 1.5 m (5 ft) intervals from the ground surface to about 3 m (10 ft) below the water table. Background samples will be analyzed for operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All background borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

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<u>Facility Soil Characterization</u>. This activity entails the characterization of contaminated or potentially contaminated soils directly associated with the south process pond, the north process pond, the 307 trenches, 307 retention basins, the process trenches, and burial grounds #4 and #5. Soil characterization at other locations within the operable unit will be driven by the results of the electromagnetic survey conducted on the process sewer (Task 1c-1), the soil tracer gas survey (Task 1e), and the surface radiation survey (Task 3a).

South Process Pond. Samples have been collected to depths of approximately 3 to 4.5 m (10 to 15 ft) beneath the south process pond. Additional sampling is required to characterize the vertical extent of soil contamination beneath the pond basins.

Vertical borings will be drilled in each of the pond basins. One boring will be centered in each of the three settling basins. An additional two borings will be drilled in each of the two infiltration basins. These borings will be located in the south central and north central portion of the basins.

Each boring will be sampled for laboratory analysis at a minimum of 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft); and, thereafter, at intervals of 1.5 m (5 ft) to a depth of about 3 m (10 ft) below the natural water table. Any changes in lithology will also be sampled. The drill cuttings and core samples obtained during borehole drilling will be continuously screened with hand-held instruments, for radiation and volatile organic compounds. These field results will be used to select representative portions of the core samples for laboratory analysis, and all results will be correlated with laboratory results to provide a more continuous information on contaminant depth distributions. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

North Process Pond. Samples have been collected to depths of approximately 3 to 4.5 m (10 to 15 ft) beneath the north process pond. Additional sampling is required to characterize the vertical extent of vadose zone contamination beneath the pond basins and in the adjacent north process pond scraping disposal area.

Vertical borings will be drilled in each of the process pond basins and in the neighboring disposal area. One boring will be centered in each of the settling basins. There are six settling basins in the north process pond. An additional three borings will be drilled in the infiltration basin. These borings will be located in the south central, central, and north central portion of the basin. Two borings will also be drilled within the adjacent north process pond disposal area.

Each boring will be sampled for laboratory analysis at a minimum of 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft); and, thereafter, at intervals of 1.5 m (5 ft) to a depth of about 3 m (10 ft) below the natural water table. Any changes in lithology will also be sampled. The drill cuttings and core samples obtained during borehole drilling will be continuously screened with hand-held instruments, for radiation and volatile organic compounds. These field results will be used to select representative portions of the core samples for laboratory analysis, and all results will be correlated with laboratory results to provide a more continuous information on contaminant depth distributions. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of I per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

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307 Trenches. Only a few samples have been collected from one end of the 307 trenches. Additional samples are required to characterize soils disposed of in the trenches as well as the extent of vadose zone contamination beneath the trenches. A total of three vertical borings will be drilled in each trench. These borings will be evenly spaced within the accessible portion of the trenches (some 300 Area structures overlie portions of the backfilled trenches).

Each boring will be sampled for laboratory analysis at a minimum of 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft) below the former trench bottoms. Thereafter, such samples will be taken at intervals of 1.5 m (5 ft) to a depth of about 3 m (10 ft) below the natural water table. Any changes in lithology will also be sampled. The drill cuttings and core samples obtained during borehole drilling will be continuously screened with hand-held instruments, for radiation and volatile organic compounds. These field results will be used to select representative portions of the core samples for laboratory analysis, and all results will be correlated with laboratory results to provide a more continuous information on contaminant depth distributions. Sample parameters selected for laboratory analysis will include the operable

unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of I per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

307 Retention Basins. Samples are required adjacent to the 307 retention basins to determine whether or not these basins have leaked. Such samples must be obtained in a manner that will not interfere with the operations or damage the integrity of this facility. Three vertical borings will be drilled immediately adjacent to the walls of the structure, one each along the west, east, and south walls. This will provide coverage at opposite ends of the two major subbasins and at the juncture of these subbasins.

Each boring will be sampled for laboratory analysis at a minimum of 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft) below the former trench bottoms. Thereafter, such samples will be taken at intervals of 1.5 m (5 ft) to a depth of about 3 m (10 ft) below the natural water table. Any changes in lithology will also be sampled. The drill cuttings and core samples obtained during borehole drilling will be continuously screened with hand-held instruments, for radiation and volatile organic compounds. These field results will be used to select representative portions of the core samples for laboratory analysis, and all results will be correlated with laboratory results to provide a more continuous information on contaminant depth distributions. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

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All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

<u>Process Trenches</u>. Both trench bottom and vadose zone sampling has been conducted for the process trenches. Additional sampling is required to determine the extent of subsurface soil contamination directly below and laterally adjacent to the process trenches.

A total of three borings will be drilled beneath the west process trench, at evenly spaced intervals to evaluate the extent of contamination below the process trenches. Two horizontal borings, one in each trench side, will be placed at each vertical boring location. Following analysis of the results from the initial borings a minimum of one additional boring will be drilled within the east trench to confirm spatial uniformity of results between the trenches. Additional borings within the east trench may be added if results from the initial three borings in the west trench indicate a need for further data.

Each vertical boring will be sampled for laboratory analysis at a minimum of 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft); and, thereafter, at intervals of 1.5 m (5 ft) to a depth of about 3 m (10 ft) below the natural water table. Any changes in lithology will also be sampled. Each horizontal

boring will be sampled for laboratory analysis at a minimum or 0.3 m (1 ft) intervals to a distance of 0.9 m (3 ft).

The drill cuttings and core samples obtained during borehole drilling will be continuously screened with hand-held instruments, for radiation and volatile organic compounds. These field results will be used to select representative portions of the core samples for laboratory analysis, and all results will be correlated with laboratory results to provide a more continuous information on contaminant depth and distance distributions. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

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<u>Burial Ground #4.</u> Burial ground #4, located in the northern portion of the 300-FF-1 Operable Unit, has not been previously sampled. This unit was used to dispose of a variety of materials containing uranium.

Three vertical borings will be drilled within the burial ground. Exact locations will be determined upon completion of the ground penatrating radar survey, at which time it may be decided to install more than three borings.

Core samples and drill cuttings obtained from the borings will be continuously sampled and analyzed with hand-held instruments for radiation and volatile organic compounds. Core samples for laboratory analysis will be collected at at least 0.5 m (1.5 ft) depth intervals through the fill material, to a depth of 1.8 m (6 ft) below the fill. Sampling will continue from this point at 1.5 m (5 ft) intervals to a depth of about 3 m (10 ft) below the water table. Changes in lithology encountered will also be sampled. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

Burial Ground #5. Burial ground #5 has not been previously sampled. This facility was used to burn materials, some of which contained uranium.

Three vertical borings will be drilled within the burial ground. Exact locations will be determined upon completion of the ground penetrating radar survey. If the survey indicates that more than three borings will be required, additional sampling locations will be allocated.

Core samples and drill cuttings obtained from the borings will be continuously sampled and analyzed with hand-held instruments for radiation and volatile organic compounds. Core samples for laboratory analysis will be collected at at least 0.5 m (1.5 ft) depth intervals through the fill material, to a depth of 1.8 m (6 ft) below the fill. Sampling will continue

from this point at 1.5 m (5 ft) intervals to a depth of about 3 m (10 ft) below the water table. Changes in lithology encountered will also be sampled. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

<u>Survey Followup Soil Characterization</u>. The purpose of this activity is to determine the nature and extent of soil contamination in areas of the operable unit identified as being potentially contaminated, as indicated by the results of the electromagnetic, soil tracer gas, and surface radiation surveys (Tasks 1c-1, 1e, and 3a, respectively).

Boreholes will be installed and sampled in representative areas along the process sewer found to be leaking during the implementation of Task 1c-1. Potential leaks found in the retired radioactive sewer, during Task 1e, will also be sampled in this manner, and soil samples will be obtained in those areas, around the process pond perimeters and to the east of the south process pond, where the radiation survey has detected statistically elevated radiation levels.

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Although borehole locations can not be determined at this time, it is assumed that five boreholes will be sampled under this portion of the soil sampling activity. Soils from these boreholes (both corings and cuttings) will be continuously sampled and analyzed with hand-held field instruments for radiation and volatile organic compounds. Core samples will be obtained for laboratory analysis at a minimum of 1.5 m (5 ft) intervals to a depth of approximately 3 m (10 ft) below the water table. Changes of lithology and areas of elevated contamination, as determined by field screening results or visual observation, will also be sampled in this manner. Core samples will be obtained at 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft) from boreholes installed where ground surfaces are determined to be contaminated by the surface radiation survey. Boreholes installed along the buried pipelines will have core samples obtained at 0.5 m (1.5 ft) intervals to a depth of 1.8 m (6 ft) below the elevation of the pipe. In both types of locations, sampling will continue to about 3 m (10 ft) below the water table at 1.5 m (5 ft) intervals. Sample parameters selected for laboratory analysis will include the operable unit contaminants of concern (Table 3-36). Physical samples will be randomly obtained at a rate of 1 per geologic stratum encountered per borehole. A determination of cation exchange capacity will be included with the physical parameters.

All borehole locations and surface elevations will be surveyed upon completion of drilling activities (see Task 3b-4).

5.3.3.2.3 Task 3b-3 - Soil Sample Analysis. Soil samples obtained for laboratory analysis under Task 3b-2 will be analyzed in a qualified laboratory.

- **5.3.3.2.4** Task 3b-4 Geodetic Survey. Boreholes sampled under this subtask will be surveyed to establish their surface elevations and N-S/E-W coordinates.
- 5.3.3.2.5 Task 3b-5 Borehole Abandonment. Upon completion of each boring installed under Task 3b-2, the borehole will be properly abandoned in accordance with regulatory requirements. A marker will be placed at each station after abandonment to allow for the geodetic survey (Task 3b-4).

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5.3.X Task X - Groundwater Investigation

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The purpose of this task is to determine the extent of groundwater contamination attributable to the operable unit, determine the rates of contaminant migration, and assess the interaction of groundwater with the adjacent Columbia River.

The operable unit groundwater investigation is divided into four subtasks:

- Task 4a Hydrogeological Data Compilation;
- Task 4b Monitoring Well and Gaging Station Installation;
- Task 4c Groundwater Sampling and Analysis; and
- Task 4d Groundwater/Surface Water Interactions.

The installation of river gaging stations is included in the groundwater investigation because of the nature of the activity involved (i.e., drilling) and the primary use of the data (i.e., to define groundwater/surface water interactions).

5.3.X.1 Task Xa - Hydrogeological Data Compilation. Considerable data on groundwater quality and hydrogeology exists from numerous sources. Integration and analysis of this data base is required to fully characterize this contaminant pathway. Compilation of the current data base will be performed at the beginning of the RI. This compilation will include both collection of data and assembly of a hydrogeological project file for use of the data.

The specific information that needs to be compiled is that included on the PNL groundwater monitoring data base. Many of the wells located near the operable unit were not included on the WHC data base used for scoping the groundwater investigation. Information regarding well completions, well logs, and any existing aquifer testing results will also be compiled.

Once the information is compiled, it will be used to refine the scope of the groundwater investigation. Well logs will be consulted to determine in which groundwater zone--shallow, intermediate, or deep--each well is completed. Groundwater quality data will be plotted to improve the current

understanding of the extent of contamination. A decision will then be made as to which wells need to be monitored during the groundwater investigation, which wells will function to provide operable unit background data, which wells require aquifer testing, and where exactly additional wells should be placed.

- 5.3.X.2 Task Xb Monitoring Well and Gaging Station Installation. This subtask is further divided into four activities:
 - Task Xb-1 Mobilization;
 - Task Xb-2 Drilling, Soil Sampling, and Well and Gaging Station Installation;
 - Task Xb-3 Soil Sample Analysis; and
 - Task Xb-4 Geodetic Survey.

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- 5.3.X.2.1 Task Xb-1 Mobilization. This activity is identical to Task 3b-1 for soil borehole sampling. The only difference will be to evaluate the additional sites, designated for groundwater monitoring well and river gaging station locations, for impacts to archeological resources.
- 5.3.X.2.2 Task Xb-2 Drilling, Soil Sampling, and Well and Gaging Station Installation. A total of three shallow wells will be installed in the southern portion of the 300-FF-1 Operable Unit. Two shallow wells will be located near the northwest and southwest corners of the south process pond. These wells will be used to determine the southern extent of groundwater plumes emanating from the process trench area. A third shallow well will be placed immediately west of the 307 process trenches. This well will be used to evaluate the existence of an identified source in this area.

A total of four intermediate wells will also be installed in the southern portion of the 300-FF-1 Operable Unit. Three intermediate wells will be located along the bordering Columbia River in the vicinity of shallow wells 3-2-3, 3-3-1 and 3-4-9. A fourth intermediate well will be placed near the northwest corner of the south process pond. These wells will be used to assess migration of contaminants (in particular trichloroethylene and trans-1,2-dichloroethylene) within the lower confined aquifer and evaluate aquifer discharge to the Columbia River.

Two river gaging stations will consist of stilling basins installed adjacent to the river along the northern and southern portions of the 300-FF-1 Operable Unit.

The wells and gaging stations will be installed by drilling, and soil core samples for laboratory contaminant analysis will be taken at approximately 1.5 m (5 ft) intervals. Soils will be continuously sampled and analyzed on-site with hand-held field instruments for radiation and volatile organic compounds. Laboratory samples will also be taken at changes in lithology or any stratum showing highly elevated levels of contaminants from field results or visual observation. One core sample from each geologic stratum encountered, randomly allocated with respect to depth, will be obtained for physical laboratory analysis.

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Monitoring well and gaging stations will be completed in accordance to Hanford Site specifications and regulatory standards.

- 5.3.X.2.3 Task Xb-3 Soil Sample Analysis. Soil samples obtained during the implementation of Task Xb-2 will be analyzed in a qualified laboratory.
- 5.3.X.2.4 Task Xb-4 Geodetic Survey. The location of each new monitoring well and gaging station will be determined. In addition, the elevation of each well will be determined to allow for accurate measurements of water levels.
- 5.3.X.3 Task Xc Groundwater Sampling and Analysis. The 300-FF-1 groundwater sampling and analysis subtask is comprised of two activities:
 - Task Xc-1 Groundwater Sampling; and

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• Task Xc-2 - Groundwater Sample Analysis.

These activities will occur four times over the course of the initial phase of the RI.

- 5.3.X.3.1 Task Xc-1 Groundwater Sampling. Groundwater monitoring wells will be sampled on a quarterly basis to obtain groundwater quality data for assessment of contaminant sources, pathways, and river discharge. Sampling will be conducted for 300-FF-1 contaminants of concern, including specific radionuclides, gross alpha and beta activity, metals, chlorinated solvents, and PCBs. Major nonmetallic ions will be used to evaluate groundwater mixing and dilution by both artificial recharge and upward flow from the lower confined aquifer.
- 5.3.X.3.2 Task Xc-2 Groundwater Sample Analysis. Groundwater samples collected during Task Xc-1 will be taken to a qualified laboratory for analysis.
- 5.3.X.4 Task Xd Groundwater/Surface Water Interactions. To characterize groundwater/surface water interaction, ten continuous monitoring points will be established. These will include two river gaging stations, six shallow aquifer zone wells, and two intermediate aquifer zone wells. Aquifer tests will be performed on wells within and near the operable unit to determine hydraulic and pressure conditions. These data will be gathered through four activities:
 - Task Xd-1 Mobilization;
 - Task Xd-2 Monitoring Well and Gaging Station Recorder Installation;
 - Task Xd-3 Data Collection and Recorder Maintenance; and
 - Task Xd-4 Aquifer Tests.
- 5.3.X.4.1 Task Xd-1 Mobilization. So that continuous measurements of river and groundwater levels, conductivity, temperature, and radiation levels can be made, the appropriate monitoring and recording equipment will be evaluated, selected, and ordered under this activity.

This mobilization activity will also include a hydrogeological decisions regarding the numbers and types of aquifer tests that need to be conducted. This decision will be based on the information compiled in Task Xa, and will take into account existing aquifer test data, well construction details, and required spatial configurations.

- 5.3.X.4.2 Task Xd-2 Monitoring Well and Gaging Station Recorder. Installation. The equipment ordered under Task Xd-1 will be installed in the two river gaging stations and eight groundwater monitoring wells. The wells will include six shallow wells: 3-1-6, 3-1-10, 3-1-17A, 3-1-16A, 3-3-12, and 3-3-9; and two intermediate wells: 3-1-17B, 3-1-16B. The wells selected lie along three cross-sections parallel to the river.
- 5.3.X.4.3 Task Xd-3 Data Collection and Recorder Maintenance. Continual measurements of river and groundwater levels, conductivity, temperature, and radiation levels will be made at the ten stations for a period of at least one year. Data recorded at these stations will be collected, and regular maintenance of the ten sets of recording instruments will be performed, under this activity.

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The use of two stations will enable the measurement of local river gradients adjacent to the operable unit. In addition, duplication of measurements will provide instrument performance checks and backup capability in the event of instrument failure. The data will be used to assess the magnitude of daily and seasonal river fluctuations. Measurements will be correlated with measured flow rates and river elevations at neighboring gaging stations including the Priest Rapids Dam, 300 Area and Richland water intakes, and any other established river gaging stations.

Simultaneous and continuous measurements of water table elevation, conductivity, temperature, and radiation levels at eight wells beneath the operable unit will be used to evaluate the influence of river level fluctuations on groundwater flow. This data will be used to determine the extent of river bank storage, the location of potential pathways of river water penetration, and the influence of fluctuations in river elevation on groundwater discharge. Estimates of average groundwater discharge rates will also be determined from the data.

5.3.X.4.4 Task Xd-4 - Aquifer Tests. Two forms of aquifer testing will be conducted. First, static water levels, on those wells which are incorporated into the 300-FF-1 RI but do not have continuous water level recorders, will be measured at more frequent intervals than quarterly during groundwater sampling. Such wells will have static water levels recorded at weekly intervals for one month following each quarterly sampling round under Task Xc-1. This information will be correlated with that obtained from the eight groundwater monitoring wells with continuous recorders.

In addition, slug or hydraulic pump tests will be performed on wells selected under Task Xd-1 to obtain information on hydraulic properties of the uppermost three groundwater zones. Where possible, slug tests will be used if the quality of the water in a particular well is such that it would require treatment prior to discharge. However, the accuracy of slug tests is limited, and the hydraulic conductivity and transmissivity of the uppermost aquifers at 300-FF-1 may well be too high to conduct these tests in an adequate manner.

If drawdown tests are necessary, and if wells can not be found which have sufficiently low contaminant levels to allow for discharge, water pumped from the wells will be contained and stored for subsequent treatment.

Results of this activity will be used for determining flow rates and directions, and values of hydraulic conductivity, transmissivity, storativity, and dispersivity for each groundwater zone.

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5.3.Y Task Y - Surface Water and Sediment Investigation

The surface water and sediment investigation for 300-FF-1 is composed of four subtasks:

- Task Ya Hydrological Data Compilation;
- Task Yb River Bank Survey;

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- Task Yc Surface Water and Sediment Sampling and Analysis; and
- Task Yd Drinking Water Sampling and Analysis.

The drinking water subtask is included here because the Columbia River is the source of drinking water in the 300 Area and the primary source for the City of Richland.

- 5.3.Y.1 Task Ya Hydrological Data Compilation. Three types of hydrological information need to be obtained before proceeding with the surface water and sediment investigation. This information will be gathered under two separate activities:
 - Task Ya-1 Columbia River:
 - Task Ya-2 300 Area and City of Richland Drinking Water: and
 - Task Ya-3 300 Area Seeps.
- 5.3.Y.1.1 Task Ya-1 Columbia River. Historical river stage and discharge measurements will be obtained from the nearest U.S. Geological Survey gaging station(s). Records of past, and predictions of future, releases will be obtained for the Priest Rapids dam. These data will allow examination of the long and short term variations in the river and the relationship between stage and discharge. It will also allow correlation with the proposed on-site river gaging stations. This information will allow prediction and determination of times of low river level necessary for the river bank survey, and the surface water and sediment sampling.
- 5.3.Y.1.2 Task Ya-2 300 Area and City of Richland Drinking Water. A literature search will be conducted to review records of water quality for the 300 Area and City of Richland water supply systems. If adequate information is available from such records, the scope of Task Yd may be reduced or eliminated.

- 5.3.Y.1.3 Task Ya-3 300 Area Seeps. A literature search will be conducted to locate any existing information on the locations and quality of surface water seeps along the operable unit into the Columbia River. If adequate information is located, the scope of Task Y may be reduced or eliminated.
- 5.3.Y.2 Task Yb River Bank Survey. The survey of the Columbia River bank, along and below the operable unit, will be conducted in four stages:
 - Task Yb-1 Bank Reconnaissance;
 - Task Yb-2 Seep Sampling;
 - Task Yb-3 Seep Sample Analysis; and
 - Task Yb-4 Geodetic Survey.
- 5.3.Y.2.1 Task Yb-1 Bank Reconnaissance. Numerous seeps and springs have been observed along the Columbia River bank adjacent to 300-FF-1. As part of this task these seeps and springs will be mapped and their discharges will be estimated. Mapping will take place at a period of low river level so that as many seeps and springs as possible can be observed. Flows will be estimated by eye to an order of magnitude accuracy. The period of low river level necessary for this task will be anticipated from historical river stage information and dam release plans.
- 5.3.Y.2.2 Task Yb-2 Seep Sampling. Water discharging from springs and seeps will be screened in the field for gross alpha and gross beta activity, temperature, pH, and conductivity. Water from major seeps and springs (5 samples are assumed for cost estimating) will be collected for laboratory analysis of all parameters of concern for the 300-FF-1 area (Table 3-36). These samples will include the springs and seeps having the highest discharges and any showing elevated parameters in the field screening. Analyses from the 300-FF-1 Operable Unit upper aquifer background monitoring wells will also be used as background for the seeps and springs.
- 5.3.Y.2.3 Task Yb-3 Seep Sample Analysis. Laboratory analysis of seep samples collected during Task Yb-2 will be conducted under this activity.
- 5.3.Y.2.4 Task Yb-4 Geodetic Survey. The locations and elevations of the seeps found during the implementation of Task Yb-1 will be determined during this activity.
- 5.3.Y.3 Task Yc Surface Water and Sediment Sampling and Analysis. This subtask is divided into five activities:
 - Task Yc-1 Geodetic Survey;

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- Task Yc-2 Near-Shore Surface Water and Sediment Sampling;
- Task Yc-3 Near-Shore Surface Water and Sediment Sample Analysis;
- Task Yc-4 Surface Water and Sediment Transect Sampling; and
- Task Yc-5 Surface Water and Sediment Transect Sample Analysis.
- 5.3.Y.3.1 Task Yc-1 Geodetic Survey. This activity will be conducted in two parts. The initial portion will be to locate and flag the 305 m (1,000 ft) coordinate lines along the bank of the Columbia River. These locations will serve as reference points for near-shore and transect sampling stations to be established under Tasks Yc-2 and Yc-4. This survey will be

initiated at the upstream coordinate line N59000, and proceed downstream at 305 m (1,000 ft) intervals to coordinate lines N58000, N57000, and so forth.

The second portion of this activity will be surveying concurrent with the implementation of Task Yc-4, the transect sampling. Surveying equipment will be required on shore to determine the exact locations of sampling points established across the river.

5.3.Y.3.2 Task Yc-2 - Near-Shore Surface Water and Sediment Sampling. Because it has been shown in the past that the contaminant plume in the river is most concentrated along the shore, near-shore samples should provide the most sensitive indication of the extent and relative concentration of any contamination. The near-shore sampling will be done during a period of low and falling river level. This will ensure that groundwater flow will be from the upper aquifer to the river under maximum gradient and that contaminant concentrations will be at their highest. The near-shore sampling will be conducted concurrently with the bank survey subtask.

Water and bottom sediment samples will be obtained adjacent to 300-FF-1 and field screened for gross alpha and gross beta activities, temperature, pH, and conductivity. Four separate samples will be upstream of the operable unit at coordinate line N59000 to determine background conditions. Single samples will be taken downstream at 305 m (1,000 ft) intervals, at each subsequent coordinate line, past the southern end of 300-FF-1 until field screened parameters decrease in concentration to the levels of the background samples.

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The sampling sequence will involve taking one of the four background samples at the start of sampling, one at the end of sampling, and the other two at approximately equal time intervals during the acquisition of the other near-shore samples. This will insure that the background samples are representative of background conditions during the entire sampling effort.

Water and sediment samples will be submitted to an analytical laboratory for analysis for contaminants of concern for the operable unit (Table 3-36).

- 5.3.Y.3.3 Task Yc-3 Near-Shore Surface Water and Sediment Sample Analysis. Samples obtained under Task Yc-2 will be analyzed in a qualified laboratory during this activity.
- 5.3.Y.3.4 Task Yc-4 Surface Water and Sediment Transect Sampling.

 Additional surface water and bottom sediment samples will be obtained from cross-river transects. These samples will be analyzed for constituents found to be present in concentrations above background based on the near-shore sampling and analysis. Statistical analyses will be performed on the results of the near-shore sampling to determine which parameters were found in concentrations significantly above background. Only these parameters will then be targeted for analysis during the cross-river transect surface water and sediment sampling.

The first transect will serve-as a background transect and will be located at coordinate line N59000. Downstream transects will be at coordinate lines at 610 m (2,000 ft) intervals throughout the area of the plume as defined by the near-shore analysis. Samples will be collected during a period of low river stage to characterized worst-case conditions.

The first sampling station in each transect will be at the shore adjacent to 300-FF-1. Additional sampling stations will be at 6, 45, and 30 m (20, 50, and 100 ft) from shore, and from there at 30 m (100 ft) intervals until an island (sandbar) or the opposite side of the river is reached. The final sampling station will be at the island or opposite shore. Additional sample stations will be included on the background transect. These will include stations on the far (eastern) shore of the island, on the opposite bank of the river, and at 90 m (300 ft) intervals between the island and the opposite shore.

Water samples will be obtained at each sampling station from the river's surface, half-way to the bottom, and 1.5 m (5 ft) off the bottom. One river bottom sediment sample will be taken at each station. Depth to bottom will be measured with an acoustic depth sounder or sounding line, whichever is more practical at the particular location.

Water samples will be obtained first at each station to avoid sampling sediment stirred up by the bottom sediment sampling procedure.

- 5.3.Y.3.5 Task Yc-5 Surface Water and Sediment Transect Sample Analysis. Surface water and sediment samples collected during Task Yc-4 will be analyzed in a qualified laboratory.
- 5.3.Y.4 Task Yd Drinking Water Sampling and Analysis. This subtask consists of two separate activities:
 - Task Yd-1 Drinking Water Sampling; and
 - Task Yd-2 Drinking Water Sample Analysis.

This subtask will be conducted for drinking water supplies for the 300 Area and the City of Richland.

5.3.Y.4.1 Task Yd-1 - Drinking Water Sampling. Three samples will be taken from each of the two water supply systems. The samples will be taken at the first taps beyond the water treatment plants. Samples will be taken during a period of low river level because it is during such periods that the highest contaminant concentrations in the river would be expected. Samples will be analyzed only for the contaminants known to be leaving the 300-FF-1 area by way of the Columbia River. These constituents will have been identified from the near-shore surface water analysis.

Samples will not be filtered prior to analysis so as to be representative of the drinking water consumed by users of the two systems.

5.3.Y.4.2 Task Yd-2 - Drinking Water Sample Analysis. Water samples collected during the implementation of Task Yd-1 will be analyzed in a qualified laboratory.

5.3.4 Task 4 - Air Investigation

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The 300-FF-1 air investigation consists of two subtasks:

- Task 4a Air Data Compilation; and
- Task 4b Ambient Air Sampling and Analysis.

5.3.4.1 Task 4a - Air Data Compilation

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This subtask is separated into two activities:

- Task 4a-I Meteorological Data Compilation; and
- Task 4a-2 Ambient Air Monitoring Program Evaluation.
- 5.3.4.1.1 Task 4a-1 Meteorological Data Compilation. Existing climatic data from the Hanford Meteorological Station will be compiled. Information describing averages and extremes of precipitation, temperature, barometric pressure, wind velocity, and evapotranspiration are required. These parameters should be averaged over the past 30 years to allow for an accurate description of average climatic conditions and variations. Frequencies and magnitudes of extreme weather events will be derived from all available information.
- 5.3.4.1.2 Task 4a-2 Ambient Air Monitoring Program Evaluation. The existing ambient air monitoring program for the 300 Area will be evaluated to augment the parameter list with soil contaminants of concern for the operable unit. The additional parameters will be incorporated into the ongoing monitoring program, which will then be implemented as Task 4b. The parameters added to the program will be those not currently included in sample analyses. The focus will be on those contaminants that are most toxic and most prevalent in the surface soils of the south and north process ponds and the process trenches (e.g., chromium). Such compounds pose the greatest threat in an air pathway due to fugitive dust emissions.

As a part of this activity, revisions to the FSP and QAPP will be made as needed, to take into account additional parameter analyses and any adjustments to the sampling procedures, locations, or frequencies that may be deemed necessary.

For scheduling and costing purposes, it is assumed that three additional parameters will be added to the ongoing program, and that no changes will be required in sampling locations, frequencies, and procedures or in analytical procedures, other than the addition of procedures to allow for added parameter analyses.

- 5.3.4.2 Task 4b Ambient Air Sampling and Analysis. The ambient air sampling and analysis will be performed under two activities:
 - Task 4b-1 Ambient Air Sampling; and
 - Task 4b-2 Ambient Air Sample Analysis.

This subtask will consist of the ongoing ambient air monitoring effort for the 300 Area, supplemented with additional soil contaminants of concern as determined under Task 4a-2.

5.3.4.2.1 Task 4b-1 - Ambient Air Sampling. Ambient air samples will be collected in accordance with ongoing procedures, locations, and frequencies, unless the evaluation conducted under Task 4a-2 indicates that adjustments are required.

5.3.4.2.2 Task 4b-2 - Ambient Air Sample Analysis. The ambient air samples collected under Task 4b-1 will be analyzed in accordance with ongoing procedures, taking the parameters added under Task 4a-2 into account.

5.3.5 Task 5 - Terrestrial Biological Investigation

The terrestrial biological investigation, as currently planned, consists of a single subtask--an on-site biological survey (Task 5a).

5.3.5.1 Task 5a - Biological Survey. This subtask consists of two activities:

- Task 5a-1 Hazardous Substances Biological Uptake Assessment; and
- Task 5a-2 Species Survey.
- 5.3.5.1.1 Task 5a-1 Hazardous Substances Biological Uptake Assessment. A visual, on-site biological survey will be performed by biologists with field experience on the Hanford Site. Any evidence of uptake of toxic substances by plants or animals will be documented, along with locations of such occurrences.
- 5.3.5.1.2 Task 5a-2 Species Survey. A qualitative species survey will be conducted within the operable unit boundaries. This survey will take the form of a literature search and will be followed up with on actual on-site survey of the operable unit surface by qualified Hanford Site terrestrial biologists. The focus of this survey will be on those species which are either endangered, threatened, economically important, or a significant component of the human food chain.

5.3.6 Task 6 - Data Evaluation

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Data generated during the phase I RI will be evaluated in an ongoing manner in order to allow decisions to be made regarding rescoping during the course of the project. The results of these evaluations will be incorporated into the monthly progress reports to make them available to project decision makers.

Data evaluation will be undertaken in subtasks corresponding to the various subcomponent investigations:

- Task 6a Source Data Evaluation;
- Task 6b Geological Data Evaluation;
- Task 6c Soil Data Evaluation;
- Task 6d Air Data Evaluation; and
- Task 6e Terrestrial Biological Data Evaluation.

The information developed in this task will be used in Task 7, the baseline risk assessment, to evaluate the overall risk posed by the operable unit to public health and the environment.

5.3.6.1 Task 6a - Source Data Evaluation. Information compiled under Task la, on the locations of the buried process and retired radioactive sewers, the nature and location of the phosphoric acid spill at the 340 complex,

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additional engineering plans and environmental reports, and interviews with former and current site personnel, will be evaluated under this subtask. Ground penetrating radar survey results from Task 1b will be graphically evaluated and used to determine borehole locations for source and soil sampling, within and beneath burial grounds #4 and #5, for Task 3b-2.

Electromagnetic survey results (Task 1c) will be plotted to determine pipeline locations and possible locations of leaks along the process sewer. Results of the soil tracer gas survey (Task 1e) will be similarly plotted to determine locations of potential leaks along the retired radioactive sewer system.

Source data evaluation will include the periodic updating of the topographic base map developed under Task 1d to incorporate sampling locations established under other investigation tasks. The updated maps produced under this subtask will be made available for plotting data generated during the project.

5.3.6.2 Task 6b - Geological Data Evaluation. Recent geological data compiled from existing sources, under Task 2a, will be formatted to provide an up to date description of the geological setting for the operable unit.

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Existing well and borehole logs, and logs from new installations put in under Tasks 3b and 4b, will be graphically formatted and used to refine existing geological and hydrostratigraphic cross sections and fence diagrams, as needed, for 300-FF-1.

5.3.6.3 Task 6c - Soil Data Evaluation. Physical soil characteristics obtained from Tasks 3b and 4b will be evaluated to provide numerical descriptions of each of the geological units present at the operable unit. Contaminant data will be statistically compared to background values to determine what soil contaminants are present at elevated levels. Contaminant data will also be plotted with respect to reveal areal and depth distributions.

NOTE: THE FOLLOWING INFORMATION, PART OF 300-FF-1 AS ORIGINALLY DEFINED, IS PRESENTED IN PRELIMINARY FORM AS A COURTESY FOR INITIAL REGULATORY REVIEW. THE FOLLOWING, NOW OFFICIALLY ENCOMPASSED WITHIN THE GROUNDWATER, SURFACE WATER AND SEDIMENT, AND AQUATIC BIOTA OPERABLE UNIT, WILL BE REVISED FOR PRESENTATION IN THE 300-FF-5 WORK PLAN.

5.3.6.X Task 6X - Groundwater Data Evaluation. Contaminant data will be statistically compared to background values for the three uppermost groundwater zones defined for the operable unit, thereby allowing for an assessment of 300-FF-1 contributions to contamination of this medium. Data will be plotted to show areal and vertical distributions of groundwater contaminants.

Flow rates and directions, under various hydrogeologic conditions, will be calculated and graphically displayed, thus defining influences of the surface water medium. Discharge and recharge zones will be delineated, and numerical descriptions of the hydraulic properties of the hydrostratigraphic units will be provided.

NOTE: THE FOLLOWING INFORMATION, PART OF 300-FF-1 AS ORIGINALLY DEFINED, IS PRESENTED IN PRELIMINARY FORM AS A COURTESY FOR INITIAL REGULATORY REVIEW. THE FOLLOWING, NOW OFFICIALLY ENCOMPASSED WITHIN THE GROUNDWATER, SURFACE WATER AND SEDIMENT, AND AQUATIC BIOTA OPERABLE UNIT, WILL BE REVISED FOR PRESENTATION IN THE 300-FF-5 WORK PLAN.

5.3.6.Y Task 6Y - Surface Water and Sediment Data Evaluation. Compiled hydrological data will be evaluated to determine seasonal and diurnal variations in flow volumes in the Columbia River. This information will be used to refine the sampling schedules for Tasks Yb-2, Yc-2, and Yc-4, which must be conducted during low flows.

Existing data on the quality of the 300 Area and Richland drinking water supplies will be evaluated to determine whether or not Task Yd needs to be implemented or modified. Existing information of the locations and water quality of seeps along the operable unit will also be analyzed to modify the scope of Task Yb, if necessary.

Locations, elevations, and relative flows of seeps along the 300-FF-1 river bank will be plotted, and relative water quality data evaluated to determine whether a preferential groundwater discharge pathway to the river exists.

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Near-shore surface water and sediment quality data will be statistically compared to background values to determine what contaminants are being contributed to these environmental media by the operable unit. Data will then be plotted against distance along the river to estimate the length of the contaminant plumes in the water column and sediments.

Data obtained from samples taken during Task Yc-4 will be plotted to determine the morphology of the river bed, the three dimensional characteristics of the water column plume, and the areal extent of sediment contamination.

Drinking water quality for the 300 Area and the City of Richland will be thoroughly described, and compared to drinking water standards.

5.3.6.4 Task 6d - Air Data Evaluation. Meteorological data compiled from HMS will be formatted and analyzed to present numerical descriptions of average climatic conditions, showing seasonal variations, and frequencies of extreme weather events. Justifications for modifications made to the ongoing ambient air monitoring program for the 300 Area will be documented under this subtask.

Results of the ambient air sampling and analysis (Task 4b) will be correlated with meteorological conditions and statistically and graphically evaluated to determine the characteristics of any atmospheric contaminant releases from the operable unit. If such releases are shown to occur in a manner which poses an imminent and substantial threat to public health or the environment, an expedited response action will be planned to address the threat.

5.3.6.5 Task 6e - Terrestrial Biological Data Evaluation. Areas determined under Task 5a-1 to show evidence of biological uptake of hazardous substances will be plotted. Any such evidence will be evaluated to determine the need for additional RI data.

Results of the species survey (Task 5a-2) will be graphically evaluated to classify 300-FF-1 habitats in terms of the presence or absence of endangered, threatened, economically important, or significant human food chain component species. Recommendations regarding points of applicability for target cleanup levels will be made to provide protection for any habitats determined to harbor such species.

5.3.7 Task 7 - Verification of Contaminant- and Location-Specific ARARs

Once the nature and extent of contamination attributable to the operable unit are well defined, EPA and Ecology will be asked to verify the potential contaminant— and location-specific ARARs. Project staff will work with the regulatory agencies and, taking unit-specific conditions into account, will decide which promulgated environmental standards, requirements, criteria, and limitations are applicable or relevant and appropriate to 300-FF-1.

5.3.8 Task 8 - Baseline Risk Assessment

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The baseline risk assessment will provide an evaluation of the potential threats to human health and the environment in the absence of any remedial action. It will provide the basis for determining whether or not remedial action is necessary and the justification for determining cleanup levels. The assessment will be developed in accordance with EPA (1986b), and will be divided into four subtasks:

- Task 8a Contaminant Identification;
- Task 8b Exposure Assessment;
- Task 8c Toxicity Assessment; and
- Task 8d Risk Characterization.

5.3.8.1 Task 8a - Contaminant Identification. The objective of this activity is to screen the RI data regarding the nature and extent of contamination so that target substances for the risk assessment can be identified. Target substances are selected on the basis of intrinsic toxicological properties, waste volumes, and environmental occurrence.

It may be useful to proceed further and select indicator contaminants as a part of this process. Indicator contaminants are selected for each of the various contaminant types present by focusing on those which are most toxic, abundant, mobile, persistent, have the greatest tendency to bioaccumulate, and for which the best information is available.

5.3.8.2 Task 8b - Exposure Assessment. The exposure assessment will identify actual or potential exposure pathways, to characterize the potentially exposed receptor (human and environmental) populations and to determine the extent of any exposure. Potentially exposed populations will be analyzed in terms of numbers and locations, and exposure levels will be estimated based upon knowledge of the nature and extent of contamination along each exposure pathway identified.

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The contaminant source, transport medium, receptor exposure point, and receptor exposure route will be identified for each exposure pathway. For each potential receptor population, the frequencies, modes, and magnitudes of exposures will be assessed. This analysis will include exposures that may occur in the future if no remedial action is undertaken, as appropriate, in addition to current exposures.

The final step of the exposure assessment will be to develop a qualitative or quantitative estimate of total exposure levels for each receptor population.

- 5.3.8.3 Task 8c Toxicity Assessment. To assess the risks associated with the release of contaminants, a comparison is performed between the acceptable levels of contamination and the actual levels identified in the exposure assessment. Contaminant-specific ARARs, when available, will be used to determine the acceptable levels. When ARARs are not available, acceptable levels will be based on environmental concentrations that will yield exposures no greater than:
 - the reference dose, for noncarcinogens; or

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a 10^{-/} to 10⁻⁴ excess lifetime cancer risk, for carcinogens.

Priority will be given to the acceptable environmental concentrations thus determined in establishing contaminant-specific cleanup levels for the final remedial action.

5.3.8.4 Task 8d - Risk Characterization. The final activity of the baseline risk assessment involves characterization of risks whenever the potential for adverse human health or environmental impacts are predicted for a receptor population. A summary of the risks posed by the operable unit will be generated. Such factors as the weight-of-evidence associated with toxicity information, estimated uncertainties associated with the previous activities, and assumptions contained within the estimates will be incorporated into the summary.

5.3.9 Task 9 - Phase I RI Report: Preliminary Operable Unit Characterization Summary

An interim report will be prepared at the end of phase I RI activities. This report will consist of a preliminary operable unit characterization summary. While a provision is made for presenting information on the baseline risk assessment, the assessment can not be expected to be finalized for this report. Treatability investigation information will also not be available for this report.

5.4 PHASE I FS - REMEDIAL ALTERNATIVES DEVELOPMENT

Chapter 3.4 of this document presented a preliminary identification of remedial action objectives, general response actions, remedial technologies, and a range of remedial alternatives for the various environmental media in Operable Unit 300-FF-1. These items were identified after a review of available data on environmental conditions within the unit.

The alternatives identified in Chapter 3.4 of the initial evaluation are broad in scope. The purpose of the first phase of the FS process is to further develop and refine the initial evaluation based on the data obtained during the RI. This refinement is accomplished through a series of steps as described below.

5.4.1 Task 1 - Development of Remedial Action Objectives

Preliminary remedial action objectives for Operable Unit 300-FF-1 were identified in Chapter 3.4. These objectives were medium-specific, and consist of goals for protecting human health and the environment. Media initially considered were soil, groundwater, surface water and sediments, air, and biota. Of these six, soils, surface water, and groundwater are known to be contaminated from operation of the facilities used for process waste disposal.

Data generated during the initial portion of the first phase of the RI will allow the preliminary remedial action objectives to be more fully developed. The development will involve the identification of specific contaminants of concern, exposure pathways, and acceptable contaminant levels or ranges of levels for each exposure route.

5.4.2 Task 2 - Development of General Response Actions

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Preliminary general response actions for Operable Unit 300-FF-1 were identified in Chapter 3.4. These response actions are medium-specific, and describe the general activities that satisfy each of the remedial action objectives. Since the response actions relate directly to the remedial action objectives, any substantial changes in the objectives, as discussed in Chapter 5.4.1, will require that the response actions be refined.

Volumes of contaminated soil and the areal extent of groundwater contamination will be defined based on the early results of the RI. Other media, such as air or surface water, will be considered if identified as being a source of unacceptable risk to human health or the environment.

5.4.3 Task 3 - Identification of Potential Remedial Technologies

The first activity to occur during this step of the FS will be to review the list of potentially applicable remedial technology types and process options presented in Chapter 3.4, in light of the initial results of the RI. Technologies and process options initially not considered may be added to the list based on available operable unit characterization data.

Once the final list of technology types and process options has been developed, a screening step will take place. During this screening step, process options and entire technology types are eliminated from further consideration on the basis of technical implementability. Technical implementability refers to the ability of the technology or process option to meet the general response action with which it is associated, given specific site conditions. At this point, an analysis will not be performed to assess the ability of the technology or process option to meet cleanup goals. For example, interceptor trenches do not accomplish the desired response action of

collection if the depth to groundwater is too great. Another example is that air stripping does not accomplish treatment if volatile contaminants are not present.

5.4.4 Task 4 - Evaluation of Process Options

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This step of the alternatives development process will consider those process options (specific processes within given technology types) considered to be technically implementable, and attempt to select one process to represent each technology type. This simplifies the subsequent development and evaluation of alternatives without limiting flexibility during remedial design.

During this step, the final list of process options will be evaluated during three subtasks with respect to effectiveness, implementability, and cost. The focus of this evaluation will be on effectiveness. A representative process will be selected for those groups of process options determined to be similar in terms of effectiveness, implementability, and cost. If two or more processes are sufficiently different in their performance or effect that one would not adequately represent the other, they will all be retained for further consideration.

Because of the presence of mixed waste, it is expected that innovative technologies will be especially applicable at the Hanford Site. However, it is likely that detailed data on their effectiveness and cost will not be available. Therefore, the evaluation of these technologies will be somewhat more liberal than would be normal. Innovative technologies will be retained based primarily on their implementability. Effectiveness and cost will not be the basis for elimination of innovative technologies from consideration unless there is clear evidence that one of these factors are limiting.

5.4.4.1 Task 4a - Effectiveness Evaluation. The effectiveness evaluation will focus on: (1) the potential effectiveness of the process options in handling the estimated areas or volumes of contaminated media and meeting the contaminant reduction goals identified in the general response action; (2) the effectiveness of the process options in protecting human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the contaminants and conditions at the operable unit.

Sufficient information to evaluate the effectiveness of process options for the various media will be collected during the RI. It is expected that a limited conceptual design of treatment processes will be required, mainly because of the probable consideration of multiple innovative technologies.

5.4.4.2 Task 4b - Implementability Evaluation. Both technical and institutional implementability are considered as part of this evaluation. Since technical implementability has already been established at this point, the emphasis will be on institutional factors. These factors are of particular importance at Hanford because of numerous unresolved issues with respect to regulatory control of mixed wastes. It is expected that assumptions regarding some of these issues will be necessary. A basis for the conceptual design of these facilities may also be developed to allow unit disposal costs to be estimated.

5.4.4.3 Task 4c - Cost Evaluation. Cost may not be the deciding factor in the evaluation of process options. Relative capital and operations and maintenance costs will be developed to the extent possible, and will be largely based on engineering judgement and experience. Processes will be evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type.

5.4.5 Task 5 - Assembly of Remedial Alternatives

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Preliminary remedial alternatives for Operable Unit 300-FF-1 were identified in Chapter 3.4. These alternatives were developed by assembling general response actions for each environmental medium under consideration. This step of the FS will involve redefining these general alternatives based on the results of the activities discussed under the previous tasks. This will mainly involve specifying the process options which comprise each alternative. For example, the preliminary soil alternative of containment could become containment by capping with long-term monitoring and maintenance. Another example could be the redefining of groundwater collection, treatment, and disposal as groundwater collection with extraction wells, treatment via chemical precipitation, and disposal by discharge to the Columbia River.

The alternatives will be kept medium-specific at this point. Although the process water disposal facilities are a source of groundwater contamination, additional sources exist both inside and outside the operable unit. This makes development of alternatives for the entire operable unit very difficult at this stage of the study.

5.4.6 Task 6 - Identification of Action-Specific ARARs

Action-specific ARARs have been preliminarily identified in Chapter 3.2. Once remedial alternatives have been assembled during this phase of the FS, the preliminary list of action-specific ARARs will be reviewed and refined, if necessary. These will provide feasibility-level design goals for the next phase of the FS.

5.4.7 Task 7 - Reevaluation of Data Needs

In the process of performing the phase I FS, additional data needs may be determined. The FS coordinator will communicate these needs to the RI coordinator so that the phase I RI can be modified, if necessary. If major additional data needs are identified, the necessary information can be obtained during the phase II RI. The phase I FS report, generated under Task 8, will serve as the formal means of documenting the data needs identified under this task.

5.4.8 Task 8 - Phase I FS Report: Remedial Alternatives Development Summary

An interim phase I FS report will be prepared upon completion of the tasks described above. The following types of information will be included:

- summary of background information supplemented with available RI data, including the nature and extent of contamination, and contaminant fate and transport;
- identification of the refined remedial action objectives and general response actions for each environmental medium of concern;
- identification and screening of remedial technology types and process options;
- selection of representative processes; and
- incorporation of selected processes into a range of alternatives.

The report will also serve as a means of identifying and communicating any reevaluations of data needs for the RI.

5.5 PHASE II FS - REMEDIAL ALTERNATIVES SCREENING

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The screening of alternatives follows the development of alternatives and precedes the detailed analysis of alternatives. The objective of alternative screening is to reduce the list of potential alternatives that will be evaluated in detail, based on their effectiveness, implementability, and cost. This screening ensures that the most promising alternatives are being considered.

Three distinct steps are conducted during the screening of alternatives. First, the alternatives selected in phase I are further refined, based on the quantities or areas of environmental media affected, the sizes and capacities of process options, and other pertinent factors obtained from the RI. Second, the refined alternatives are evaluated on a general basis to determine their effectiveness, implementability and cost. Third, the alternatives best able to meet the remediation objectives of protection of human health and the environment are retained for detailed analysis in phase III of the FS.

5.5.1 Task 1 - Refinement of Remedial Action Objectives

Alternatives are developed in phase I of the FS to meet remedial action objectives for each medium of interest. However, exposures may occur through more than one pathway and involve several environmental media. The assembled alternatives are thus evaluated to ensure that they protect human health and the environment from all potential pathways at the operable unit. If it is found that an alternative is not fully protective, a reduction in exposure levels may need to be made for one or more media, or it may be determined that a specific alternative is unable to meet a target risk level and would, therefore, not be retained. Conversely, it may be determined that certain media do not pose an unacceptable risk, and treatment alternatives could then

possibly be eliminated from further evaluation. An example of a medium for which remediation may be unnecessary is air.

Information obtained in the RI will be used to refine the objectives to consider media interactions so that alternatives are fully protective of public health and the environment.

5.5.2 Task 2 - Definition of Remedial Alternatives

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Prior to beginning the screening, alternatives must be further defined to identify individual process options, process sizing requirements, and remediation time frames. Results from the RI will be used to determine interactions among environmental media, which may influence remediation activities. Alternatives will be redefined, as necessary, to provide for protectiveness for the entire operable unit.

The information collected during the RI will be used to refine the extent or volume of contaminated material and the size of major technology and process options in order to allow differentiation among alternatives with respect to effectiveness, implementability, and cost.

Media interactions will be evaluated to determine if ongoing releases (such as from contaminated soils) significantly affect contaminant levels in other media (such as groundwater). This is necessary because source control actions affect remediation levels and time frames for other media. For example, source removal of contaminated soils would reduce the rates and volumes of groundwater extraction needed to achieve the target remediation levels.

After defining the alternatives, the technology process options will be further defined with respect to effectiveness, implementability, and costs in order to identify differences among alternatives. The following information will be developed for the technology process options used in an alternative:

- size and configuration of on-site extraction and treatment systems;
- time frame in which treatment, containment, or removal goals can be achieved;
- rates or flows of treatment;
- special requirements for construction;
- distances for disposal technologies; and
- required permits and imposed limitations.

5.5.3 Task 3 - Screening Evaluation

In the screening evaluation, information assembled in the further definition of alternatives is used to evaluate the alternatives with regard to the short- and long-term aspects of effectiveness, implementability, and cost.

During this screening, comparisons will be made between similar alternatives, with the most promising carried forward for further analysis.

Alternatives with the most favorable composite evaluation of all factors will be retained for further consideration during the detailed analysis. Alternatives selected, to the extent practicable, will preserve the range of treatment and containment technologies initially developed. No more than ten alternatives will be retained. Unselected alternatives may be reconsidered at a later step in the detailed analysis if information is developed that identifies an additional advantage not previously apparent. However, it is expected that alternatives eliminated during this phase will not be reconsidered for selection.

5.5.3.1 Task 3a - Effectiveness Evaluation. Each alternative will be evaluated with respect to the level of protectiveness to human health and the environment it will provide through reductions of waste in terms of toxicity, mobility, or volume. The short-term component, occurring during the construction and operation period, and the long-term component, occurring after the remedial action alternative has been completed, will be evaluated. Levels obtained in reduction of toxicity, mobility, or volume will be compared to contaminant-specific ARARs or to target risk levels.

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- 5.5.3.2 Task 3b Implementability Evaluation. Implementability is a measure of both the technical and institutional feasibility of constructing, operating, and maintaining a remedial action alternative with respect to a specific site. Technical feasibility refers to the ability to construct, operate, and meet technology-specific regulations for process options; institutional feasibility refers to the ability to obtain approvals from federal, state, and local agencies, and to procure required services and equipment.
- 5.5.3.3 Task 3c Cost Evaluation. Comparative cost estimates with relative accuracy will be made. Cost estimates will be based on cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates. Both capital and operating and maintenance costs will be considered where appropriate. Present worth analyses will be used to evaluate expenditures that occur over different time periods, so that costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative.
- 5.5.3.4 Task 3d Evaluation of Innovative Alternatives. Innovative technologies are those technologies which are fully developed but which lack sufficient cost or performance date for routine use at hazardous waste sites. Therefore, it will most likely not be possible to evaluate alternatives incorporating innovative technologies on the same basis as available technologies. However, innovative technologies will be carried through the screening phase if there is reason to believe that they offer significant advantages. It is anticipated that innovative technologies may be attractive alternatives at the Hanford Site due to the presence of mixed wastes.

5.5.4 Task 4 - Verification of Action-Specific ARARs

At the conclusion of screening, sufficient information will exist on the technologies and configurations of greatest interest to perform a more definitive identification of action-specific ARARs. Action-specific ARARs previously identified will be refined with input from the federal and state environmental regulatory agencies.

5.5.5 Task 5 - Reevaluation of Data Needs

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Once the field of alternatives have been narrowed, the need for treatability tests can be determined. This testing will occur during the phase II RI. Additional data needs may also be identified during the screening phase. However, it is expected that the nature and extent of contamination will be well defined by the end of the RI. Therefore, any additional field investigations will focus on better defining the effect of operable unit conditions on the performance of the technology processes of greatest interest. Data quality objectives will be the same as those discussed in Chapter 4 for any additional investigations.

5.5.6 Task 6 - Phase II FS Report: Remedial Alternatives Screening Summary

The results of the initial screening of alternatives will be incorporated into an interim FS. The procedures for evaluating, defining, and screening the alternatives will be well documented. The following types of information will also be included:

- definition of each alternative including extent of remediation, volume of contaminated material, sizes of major treatment processes, process parameters, cleanup time frames, transportation distances, and special considerations;
- notation of process options that were initially screened out and are being represented by the processes comprising the alternative; and
- screening evaluation summaries of each alternative.

A reevaluation of data needs for the phase II RI will be included in this report.

5.6 PHASE II RI - TREATABILITY INVESTIGATION

As operable unit information is collected during the RI and alternatives are being developed, additional data needs necessary to adequately evaluate alternatives during the detailed analysis may be identified. Activities may include the collection of additional necessary operable unit characterization data, or the performance treatability studies to better evaluate technology performance.

Some of the technologies selected for detailed analysis at the Hanford Site may be well developed, proven, and documented such that site-specific information collected during the RI is adequate for evaluation without conducting treatability testing. However, it is expected that some technologies, particularly those dealing with mixed waste, will not have been sufficiently demonstrated to predict treatment performance or to estimate the size and cost of treatment units. Some treatment processes, particularly innovative technologies, are not sufficiently understood for performance to be predicted, even with a complete characterization of the wastes. When treatment performance is difficult to predict, actual testing of the process may be the most cost-effective means of obtaining the necessary data.

The purpose of the treatability investigation is to provide information needed for the detailed analysis of alternatives and to allow selection of remedial actions to be made with a reasonable certainty of achieving the response objectives. The results of bench and pilot tests can be used to ensure that conventional and innovative technologies are evaluated during the detailed analysis portion (phase III) of the FS.

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Information collected during treatability studies can also aid in the detailed design of the selected remedial technology. However, the limitations of the bench- or pilot-scale test must be compensated for in a full-scale application. Therefore, an evaluation which includes a sensitivity analysis to identify the key parameters and unknowns that could affect a full-scale system, would be conducted. In the case of innovative technologies, full-scale systems may not be in wide use. Therefore, the potential need for process modifications during design or operation must be considered.

If and when it becomes apparent that it will be necessary to implement a second phase of the RI, this portion of the work plan will be expanded by amendment to provide details of the phase II activities. The accompanying volumes of the overall RI/FS project plan, and pertinent portions of this work plan, will also be amended as appropriate.

The need for any additional characterization of the operable unit will be apparent once phase II of the FS is completed. The phase II RI will focus on obtaining information to support the phase III FS. The phase I RI, phase I FS, and phase II FS reports will provide interim evaluations of further data needs for the phase II RI.

Prior to initiating the phase II RI, this work plan and accompanying sampling and analysis and health and safety plans will be amended, as appropriate, to provide guidance for the required work.

5.6.1 Task 1 - Treatability Investigation Work Plan Development

Data collected during operable unit characterization may not be adequate for assessing the feasibility of remedial technologies, and the need for detailed data from treatability tests may not become apparent until the initial screening of alternatives has been completed. Additional data may also be required for innovative technologies.

A literature survey will be conducted to identify additional data needs. The objectives of the survey are:

- determine whether the performance of those technologies under consideration have been sufficiently documented on similar wastes considering the scale, e.g., bench, pilot or full, and determine the number of times the technologies have been successfully used;
- gather information on relative costs, applicability, removal efficiencies, operations and maintenance requirements, and implementability of the candidate technologies; and
- determine testing requirements for bench or pilot studies.

Treatability testing to support the remedial alternative evaluation and design process can be performed by using bench-scale or pilot-scale techniques. In general, treatability studies will include the following steps:

- preparation of a work plan for the bench or pilot studies;
- performance of the field investigations, bench or pilot testing;
- evaluation of data from field investigations, bench or pilot testing;
- incorporation of the results of the testing into the RI report.

Bench-scale testing may be performed to determine if a process is technically feasible for some alternatives involving treatment or destruction technologies. Prior to initiating bench-scale treatability tests, the following information will be collected or developed:

test procedures;

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- a waste sampling plan;
- waste characterization;
- treatment goals;
- data requirements for estimating the cost of the technology being evaluated; and
- required test services, equipment chemicals; and analytical services.

Bench tests can be used to test for a wide variety of operating conditions, and can be used to determine broad operating conditions to allow optimization during additional bench or larger-scale pilot tests. The objectives of bench-scale testing are to determine the following:

- effectiveness of the treatment alternative on the waste;
- differences in performance between competing manufacturers;

- differences in performance between alternative chemicals;
- sizing requirements for pilot scale studies;
- screening of technologies to be pilot-tested;
- sizing of those treatment units that would affect the cost of the technology sufficiently to affect the feasibility study evaluation process; and
- compatibility of materials with the waste.

For a technology that is well developed and tested, bench studies are usually sufficient to evaluate performance on new wastes. For innovative technologies, however, pilot tests may be required since information necessary to conduct full-scale tests is either limited or nonexistent.

Pilot units are intended to more accurately simulate the operation of the full-scale process than would bench-scale testing. However, pilot tests require significant time and can be quite costly. Therefore, the need for pilot testing must be determined by comparing the potential for improved performance or savings in time or money during implementation against the additional time and expense for the pilot testing. Innovative technologies will be considered if they offer the potential for more permanent treatment destruction of the waste, or significant savings in time or money required to complete a remedial action.

5.6.2 Task 2 - Treatability Investigation Implementation

This task is reserved for the actual implementation of any treatability investigation, or additional operable unit characterization, activities deemed necessary. The results of this task will be integrated into the preliminary site characterization summary to create the final RI report.

5.6.3 Task 3 - RI Report

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The treatability investigation results will describe the testing that was performed, the results of the tests, and an interpretation of how the results would affect the evaluation of the remedial alternatives considered for the site. The report will contain a discussion of the effectiveness of the treatment technology for the wastes on-site, and will contain an evaluation of how test results affect treatment costs developed during the detailed analysis of alternatives. These results will be combined with the operable unit characterization results and published as the final report documenting all investigation activities for the project.

5.7 PHASE III FS - REMEDIAL ALTERNATIVES ANALYSIS

The detailed analysis of alternatives follows the development and screening of alternatives and precedes the actual selection of the remedial action alternative to be implemented at the operable unit. The results of the

detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed operable unit plan. The detailed analysis of alternatives consists of the following components:

- further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated environmental media to be addressed, the technologies to be used, and any performance requirements associated with those technologies;
- an assessment and a summary of each alternative against nine evaluation criteria; and
- a comparative analysis among the alternatives to assess the remedial action.

5.7.1 Task 1 - Definition of Remedial Alternatives

The alternatives that remain after screening may need to be defined more completely prior to the detailed analysis. During the detailed analysis, each alternative will be reviewed to determine if additional definition is required to apply the evaluation criteria consistently and to develop order-of-magnitude cost estimates (-30 to +50 percent). Information developed to further define alternatives at this stage may include preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative. Information collected from treatability investigations, if conducted, will also be used to further define alternatives.

5.7.2 Task 2 - Detailed Analysis of Remedial Alternatives

Nine evaluation criteria will serve as the basis for conducting the detailed analysis and for subsequent selection of an appropriate remedial action. The evaluation criteria are:

- short-term effectiveness:
- long-term effectiveness and permanence:
- reduction of toxicity, mobility, or volume;
- implementability;
- cost;

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- compliance with ARARs;
- overall protection of human health and the environment;
- environmental agency acceptance; and
- community acceptance.

These criteria encompass technical, cost, and institutional considerations, compliance with specific statutory requirements, and community relations concerns. Each criterion will be analyzed under a separate subtask.

5.7.2.1 Task 2a - Short-Term Effectiveness Analysis. This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until remedial action objectives are met. The following

factors relating to effects on human health and the environment will be addressed for each alternative:

- protection of the community during construction and implementation;
- protection of workers during construction and implementation;
- environmental impacts during construction and implementation; and
- time until remedial action objectives are achieved.

The evaluation of these factors will include a discussion of increased risk posed by the remedial alternative being evaluated and an evaluation of the effectiveness and reliability of protective measures that could be taken for worker protection or environmental impact mitigation. This is of particular concern at the Hanford Site because of the inherent problems concerning mixed wastes.

5.7.2.2 Task 2b - Long-Term Effectiveness Analysis

The evaluation of alternatives using this criterion will address the results of a remedial action in terms of the risk remaining at the operable unit after response objectives have been met. The following components will be addressed to evaluate the extent and effectiveness of controls that may be required to treat residuals or untreated wastes:

- magnitude of remaining risk;
- adequacy of controls; and
- reliability of controls.

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The evaluation of these components will include an assessment of residual risk, the adequacy of containment systems and institutional controls, and the potential need to replace components of the remedial alternative.

- 5.7.2.3 Task 2c Analysis of Reduction in Waste Toxicity, Mobility, and Volume. This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of a hazardous substance as their principal element (CERCLA 121 (b)(1)). The following specific factors will be addressed:
 - the treatment processes, the remedies they will employ, and the materials they will treat;
 - the amount of hazardous materials that will be destroyed or treated:
 - the degree of expected reduction in toxicity, mobility, or volume as a percentage of reduction;
 - the degree to which treatment will be irreversible; and
 - the type and quantity of treatment residuals that will remain.

Alternatives which treat a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volumes of contaminated media will satisfy the preference for permanent treatment.

- 5.7.2.4 Task 2d Implementability Analysis. The implementability criterion addresses the technical and institutional feasibility of implementing an alternative and the availability of various services and materials required during its implementation. In evaluating this criterion, the following factors will be analyzed:
 - technical feasibility including: construction and operation, reliability of technology, ease of undertaking additional remedial actions, and monitoring considerations;
 - institutional feasibility; and

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availability of services and materials;

Concerns at the Hanford Site regarding implementability are related to the presence of mixed wastes. Assumptions may be necessary with respect to future mixed waste regulations and guidelines.

- 5.7.2.5 Task 2e Cost Analysis. Cost considerations will be an important evaluation criteria at the Hanford Site because funding is distributed by the U.S. Congress. Costing procedures outlined in the Remedial Action Costing Procedures Manual (EPA, 1985) will be used in the alternatives evaluation. Both capital costs and annual operation and maintenance costs will be considered. Cost will be developed within accuracy of -30 to +50 percent (EPA, 1985; EPA, 1988b). In addition, a present worth analysis will be conducted so that all alternatives can be compared on the basis of a single figure in a common base year. A discount rate of 5 percent will be used along with a period of performance of 30 years.
- 5.7.2.6 Task 2f Analysis of Compliance with ARARs. This evaluation criterion is used to determine how each alternative complies with ARARs. The detailed analysis will summarize which federal and state environmental standards, requirements, criteria, or limitations are applicable or relevant and appropriate to an alternative. How the alternative meets these requirements will be described.
- 5.7.2.7 Task 2g Analysis of Overall Protection of Public Health and the Environment. This evaluation criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors discussed under long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The analysis will address how each specific alternative achieves protection over time and how operable unit risks are reduced. A discussion will be included of how each source of contamination is to be eliminated, reduced, or controlled for each alternative.
- 5.7.2.8 Task 2h Analysis of Environmental Agency Acceptance. Because EPA and Ecology will have an opportunity to review and comment on the FS report, this analysis will be limited to formal comments made by the agencies during previous phases of the RI/FS. Agency comments on the remedial alternatives analysis phase will be specifically addressed in a responsiveness summary prior to finalization of a record of decision.

Therefore, the analysis of this criterion will focus on those features of alternatives that EPA or Ecology have reservations about or oppose. A brief discussion of what processes were used to incorporate environmental agency inputs to the project will be included.

5.7.2.9 Task 2i - Analysis of Community Acceptance. The potentially impacted community, special interest groups, the general public, and other interested governmental agencies will have an opportunity to review and comment on the FS report as well. Before the record of decision is developed, community concerns will also be addressed in the responsiveness summary. Thus, this analysis will also be confined to community concerns formally transmitted to project management personnel earlier in the RI/FS. A discussion of the processes used to solicit and address such concerns will be included.

5.7.3 Task 3 - Comparison of Remedial Alternatives

Once the alternatives have been individually assessed against the nine criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. The key trade offs or concerns among alternatives will generally be based on the evaluations of short-term effectiveness; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; implementability; and cost. Overall protectiveness and compliance with ARARs will generally serve as a threshold determination in that they either will or will not be met.

The comparative analysis will include a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion. The potential advantages in cost or performance of innovative technologies and the degree of uncertainty in their expected performance will also be discussed. The differences between all the alternatives will be summarized in tabular form.

At this point the separate alternatives for each of the environmental media will be combined to present a comprehensive partial remedy that addresses all the potential threats posed by the operable unit.

5.7.4 Task 4 - FS Report

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The analysis of individual alternatives against the nine criteria will be presented as a narrative discussion accompanied by a summary table. The alternatives discussion will include data on technology components, quantity of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. The key ARARs for each alternative will also be incorporated into those discussions. The discussion ill focus on how, and to what extent, the various factors within each of the nine criteria are addressed. A summary table will highlight the assessment of each alternative with respect to each of the nine criteria.

6.0 SCHEDULE

The anticipated schedule for completing the RI/FS is presented in Figure 6-1. Assumptions that were used in developing this schedule include:

- it will not be feasible to drive gas probes for Task le-2;
- two drill rigs will be used during Tasks le-2 and 3b-2;
- drilling contractors will be prequalified, thereby eliminating the need to undertake a competitive bid process immediately prior to drilling;
- laboratory analysis of samples will take six to eight weeks;
- it will take two months to develop procedures for activities for which there are none currently approved;
- WHC and DOE reviews of draft documents will take six weeks;

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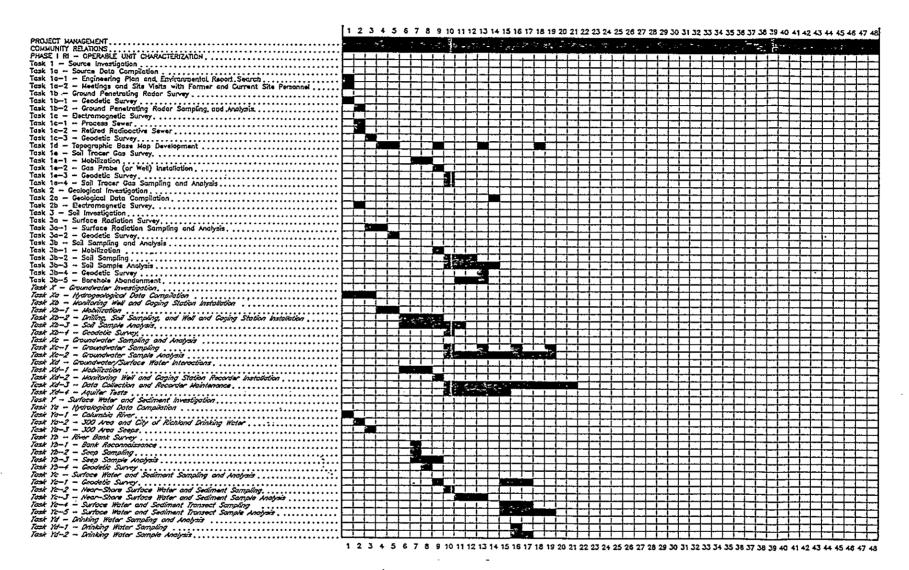
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- regulatory review of the Phase II RI and Phase II FS reports will take seven months; and
- existing groundwater monitoring wells to be incorporated into the RI are adequately constructed and are useable for the intended purposes.

There is a high degree of uncertainty associated with the anticipated schedule for the Phase II RI. Specific tasks are not now identified, because the actual scope of this phase will be dependent on the results of the Phase I RI and the Phase I and Phase II FS.

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7.0 PROJECT MANAGEMENT

Details on the management structure, organization, and responsibilities for the RI/FS project are provided in the PMP (Attachment 3).

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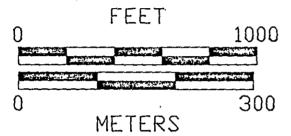


PLATE 2-1 300 AREA OPERABLE UNITS

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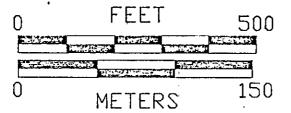


PLATE 2-2 300-FF-1 OPERABLE UNIT

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ATTACHMENT 1 SAMPLING AND ANALYSIS PLAN

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This Sampling and Analysis Plan (SAP) consists of two parts:

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150 Attachment la - Field Sampling Plan (FSP)
 Attachment lb - Quality Assurance Project Plan (QAPP)

The FSP and QAPP each conform with current draft EPA guidance in terms of content and format.

The FSP contains information pertinent to activities that need to be conducted in the field. The QAPP discusses the quality assurance/quality control (QA/QC) measures to be followed to ensure the useability and defendability of the data collected during the RI.

ATTACHMENT 1a FIELD SAMPLING PLAN

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1.0 INTRODUCTION

This plan, Attachment 1-1 to the 300-FF-1 RI/FS work plan, is written for those who are assigned responsibility for obtaining field samples for the operable unit RI/FS. The FSP, while perhaps the best plan for the field person to first study before venturing out into the field, is designed to be used in conjunction with the 300-FF-1 RI/FS work plan, other attachments to that plan, and referenced procedures.

The actual work plan contains important summaries on the background for operable unit 300-FF-1 in the first three chapters. The work plan contains a list of acronyms and abbreviations that are also used in this document. The field person should also be aware of the project schedule contained within Chapter 6 of the work plan (or the most recent available update of that schedule).

The QAPP, Attachment 1-2 to the work plan, is an essential document to be familiar with because it describes, among other things, the equipment and procedures that must be used during this project to obtain good representative field samples and on-site analytical results. Knowledge of the HASP (Attachment 2) is critical because it specifies procedures to be followed to ensure the occupational health and safety of field personnel working on the project. And, because field persons must maintain field notebooks containing vital project data, familiarity with applicable data management procedures specified in the DMP (Attachment 4) is also necessary.

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Because the operable unit characterization phase of the RI is the only phase which contains field sampling requirements at this time, the FSP is outlined in the format corresponding to the phase I RI tasks, subtasks, and activities. For completeness, those phase I RI components that do not involve any field sampling are also briefly addressed in this plan. If additional field sampling requirements are determined to be needed, in the operable unit characterization or other phases of the project, this document will be amended to incorporate such requirements.

2.0 PHASE I RI TASK 1 - SOURCE INVESTIGATION

This task is designed to provide necessary information regarding the locations, structure, and integrity of certain hazardous waste facilities within the operable unit, and to validate the results of project scoping efforts.

2.1 TASK IA - SOURCE DATA COMPILATION

This subtask does not involve any field sampling.

2.2 TASK 1B - GROUND PENETRATING RADAR SURVEY

2.2.1 Task 1b-1 - Geodetic Survey

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- 2.2.1.1 Sampling Objectives. The objective of this activity is to establish grids upon which the actual ground penetrating radar survey will be done. The grid will serve as sampling transects for the radar survey and will provide reference points for data obtained. All surveying for this project will be tied into the Hanford Site coordinate system.
- 2.2.1.2 Sample Locations and Frequencies. The grids will be established on burial grounds #4 and #5. They will be grids of 7.6 m (25 ft) intervals. The grid coordinates around the boundaries of the two burial grounds will be surveyed and staked one time to establish the transect lines for the radar survey.
- 2.2.1.3 Sample Designations. Not applicable.
- 2.2.1.4 Sampling Equipment and Procedures. Surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- 2.2.1.5 Sample Handling and Analysis. This survey will locate and stake out reference points, with third order precision and accuracy, along the boundaries of the two burial grounds. Transect lines can then be run between opposing stakes. Data will be recorded in a field notebook which will be handled in accordance with procedures specified in the QAPP and DMP. WHC will take administrative measures to ensure that the reference stakes are not disturbed until after Task 1b-2 is completed.
- 2.2.2 Task 1b-2 Ground Penetrating Radar Sampling and Analysis
- 2.2.2.1 Sampling Objectives. The goals of this activity are to:
 - determine the depths of fill in burial grounds #4 and #5;
 - determine and locate any subsurface structure, such as a parallel trench configuration, within the two burial grounds; and

- determine whether any buried containers, such as drums, exist within the burial grounds and, if so, provide their locations.
- 2.2.2.2 Sample Locations and Frequencies. The actual implementation of the radar survey will be a one time occurrence for each of the two burial grounds. A 7.6 m (25 ft) grid will be established under Task 1b-1, and this coordinate system will provide the transect lines upon which the radar data will be obtained. Sampling transects will run the length of each burial ground at 7.6 m (25 ft) intervals. Transects perpendicular to the first set, across the entire width of each facility, will also be sampled.
- 2.2.2.3 Sample Designations. The grid coordinates established under Task 1b-1 will be designated A, B, C, ... along the length of each facility, and A', B', C', ... along the opposing length. The width coordinates will be designated 1, 2, 3, ... and 1', 2', 3', ..., respectively. Each transect sampled will therefore be designated by the endpoint coordinates, with the starting point of the sampling run coming first (e.g., A-A' or 2'-2).

To distinguish between the two burial grounds, the codes BG4 and BG5 will preface the transect designator (e.g., BG4A-A' or BG52'-2).

2.2.2.4 Sampling Equipment and Procedures. The ground penetrating radar survey will be conducted along transects run between opposing stakes sited in Task 1b-1. Results will be plotted as to location by reference back to the established grid systems.

Sampling equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP. Equipment shall, at a minimum, be capable of penetrating 4.6 m (15 ft).

2.2.2.5 Sample Handling and Analysis. Radar logs and field notes will be generated on-site and will be handled in accordance with the DMP and QAPP procedures. Sample analysis will consist of interpretation of the logs and notes.

2.3 TASK 1C - ELECTROMAGNETIC SURVEY

2.3.1 Task 1c-1 - Process Sewer

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- 2.3.1.1 Sampling Objectives. The purpose of this activity is twofold:
 - determine the exact location of the buried process sewer lines; and
 determine which sections of the lines are leaking process sewage.
- 2.3.1.2 Sample Locations and Frequencies. The approximate location of the process sewer pipeline is shown in Plate 2-2 in the work plan. An activity under Task la will compile existing plans to attempt to locate this facility more accurately. The electromagnetic sampling will occur over the entire length of the process sewer system which is located within the operable unit boundaries. This survey will be performed one time.

- 2.3.1.3 Sample Designations. Stakes will be used to determine both the position of the sewer line and the locations of pipeline leaks. Different colors will be used to distinguish between these two determinations to avoid confusion during the geodetic survey to be performed under Task 1c-3.
- 2.3.1.4 Sampling Equipment and Procedures. Details on electromagnetic sampling equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- 2.3.1.5 Sample Handling and Analysis. Results of the process sewer electromagnetic survey will be demarcated in the field by two types of stakes. One will indicate the location of the sewer line route; the other will indicate leaks from the pipeline. Data will be recorded in a field notebook to supplement the staked locations. All field data will be handled in accordance with QAPP and DMP procedures. WHC will implement administrative measures to ensure that the stakes are not disturbed until the completion of Task 1c-3.

2.3.2 Task 1c-2 - Retired Radioactive Sewer

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- 2.3.2.1 Sampling Objectives. A literature and plan search will be undertaken pursuant to Task la to attempt to accurately locate the retired radioactive sewer pipelines within 300-FF-1. The approximate locations are indicated in Plate 2-2 of the work plan. If necessary, this activity will be conducted to precisely locate the buried stainless steel lines.
- 2.3.2.2 Sample Locations and Frequencies. If this activity is conducted, it will be performed one time over the entire length of that portion of the sewer which is located within the operable unit boundaries.
- 2.3.2.3 Sample Designations. The location of the retired radioactive sewer pipeline route will be staked out as the electromagnetic survey proceeds. These stakes will use a color designator different from the two used in Task 1c-1.
- 2.3.2.4 Sampling Equipment and Procedures. Details on electromagnetic sampling equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- 2.3.2.5 Sample Handling and Analysis. Results of this survey will be displayed in the field by staking the location of the sewer line route. Data will be recorded in a field notebook to supplement the staked locations. All field data will be handled in accordance with the DMP and QAPP. Administrative precautions will be taken to ensure that the stakes are not disturbed until after Task 1c-3 is completed.

2.3.3 Task 1c-3 - Geodetic Survey

2.3.3.1 Sampling Objectives. The purpose of this activity is to survey the locations of the buried process and retired radioactive sewers, as determined in Tasks 1c-1 and 1c-2, respectively. In addition, locations of leakage of process sewage from the process sewer lines will also be determined under this activity. The ultimate goal is to incorporate the locations of the two sewer

pipelines onto the topographic base map (Task 1d). Locations of leakage points will also be ultimately plotted on the base map for subsequent data interpretation. All surveying for this project will be tied into the Hanford Site coordinate system.

- 2.3.3.2 Sample Locations and Frequencies. This activity will take place within the operable unit boundary, along the routes of the two sewer pipelines. Stakes installed under Tasks 1c-1 and 1c-2 will cover the area of interest.
- 2.3.3.3 Sample Designations. Not applicable.
- 2.3.3.4 Sampling Equipment and Procedures. Details on the surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- 2.3.3.5 Sample Handling and Analysis. Data will be recorded in a field notebook and handled in accordance with the procedures specified in the DMP and QAPP.
- 2.4 TASK 1D TOPOGRAPHIC BASE MAP DEVELOPMENT

2.4.1 Sampling Objectives

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The purpose of this subtask is to develop a topographic map of the operable unit, having third order precision and accuracy, 1:2,400 scale, and 0.6 m (2 ft) elevational contour intervals. This map will be used to:

- accurately indicate locations of operable unit facilities;
- accurately indicate locations of RI sampling stations;
 evaluate surface runoff drainage patterns;
- plot data to evaluate areal extent of contamination; and
- evaluate remedial alternatives.

2.4.2 Sample Locations and Frequencies

The map will encompass the entire operable unit, extending 100 m (330 ft) past the operable unit boundaries.

Development of a comprehensive operable unit map will be somewhat of an ongoing process during the project. Geodetic control and survey activities are specified for each appropriate investigational subtask. The surveying needed to determine facility locations and surface elevations, and base map development, will be performed under this subtask. As new sampling stations are established under other RI tasks, additional geodetic surveying and updating of the map will occur.

2.4.3 Sample Designation

Not applicable.

2.4.4 Sampling Equipment and Procedures

Details on the surveying and mapping equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.

2.4.5 Sample Handling and Analysis

All field data obtained during this activity will be recorded in a field notebook, and the notebook will be handled in accordance with the DMP and QAPP.

2.5 TASK 1E - SOIL TRACER GAS SURVEY

2.5.1 Task le-1 - Mobilization

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This activity does not involve any field sampling.

2.5.2 Task le-2 - Gas Probe (or Well) Installation

- 2.5.2.1 Sampling Objectives. The purpose of this activity is to install soil gas sampling stations along the route of the retired radioactive sewer, within the boundaries of 300-FF-1. These stations will be used to detect any tracer gas leaking from the pipeline, thereby locating sections of the pipeline which could have leaked radioactive sewage during the time the line was in service.
- 2.5.2.2 Sample Locations and Frequencies. Gas probes will be driven, or gas wells will be drilled and installed, (depending on decisions made during Task le-1) along the retired radioactive sewer line at intervals of 9 m (30 ft). A single round of installations will be required.
- 2.5.2.3 Sample Designations. Probes will each be assigned a unique number preceded by the designator TG to indicate that it is a tracer gas sampling station (e.g., TG1, TG2, TG3, ...).
- 2.5.2.4 Sampling Equipment and Procedures. The soil gas sampling probes or wells will be installed along the route of the retired radioactive sewer to depths just above or alongside the pipeline (approximately 3 m or 10 ft) at 9 m (30 ft) intervals along the length of the pipeline. The installations will provide a means for obtaining a sample of soil gas to look for the presence of the tracer gas placed within the pipeline.

Procedures and equipment for installing the gas probes or gas wells shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.

2.5.2.5 Sample Handling and Analysis. No physical samples will be obtained during implementation of this activity. A field notebook will be kept, however, and soil conditions and other relevant matters will be recorded. These notes will be handled in accordance with the DMP and QAPP.

2.5.3 Task le-3 - Geodetic Survey

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- 2.5.3.1 Sampling Objectives. The objective of this activity is to determine the locations of the gas probes (or wells) installed under Task le-2, so that this information can be added to the operable unit topographic map. All surveying for this project will be tied into the Hanford Site coordinate system.
- 2.5.3.2 Sample Locations and Frequencies. This activity will be a one time event, and will be performed to locate each of the tracer gas sampling points established along the length of the retired radioactive sewer.
- 2.5.3.3 Sample Designations. Not applicable.
- 2.5.3.4 Sampling Equipment and Procedures. Details on the surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- 2.5.3.5 Sample Handling and Analysis. Data obtained will be recorded in a field notebook and handled in accordance with the DMP and QAPP. Results will be used to update the topographic base map.
- 2.5.4 Task le-4 Soil Tracer Gas Sampling and Analysis
- 2.5.4.1 Sampling Objectives. The purpose of this activity is to locate sections of the retired radioactive sewer which could have leaked radioactive sewage during the time this facility was in use. Potential leakage points will be found through the detection of a tracer gas placed in the sewer line under pressure.
- 2.5.4.2 Sample Locations and Frequencies. Once the sewer line is pressurized with the tracer gas, the actual soil gas sampling will occur one time at each station established under Task le-2.

These stations will be located along the length of the pipeline, within the operable unit boundaries, at 9 m (30 ft) intervals.

- 2.5.4.3 Sample Designations. Samples will be designated according to the gas sampling station from which the sample is derived (e.g., TG1, TG2, TG3, ...).
- **2.5.4.4 Sampling Equipment and Procedures.** Samples of soil gas will be obtained from each sampling point to allow for an on-site determination of the quantity of tracer gas, if any, by gas chromatography. Details of on-site soil gas sampling and analysis procedures and equipment, along with those for pipeline tracer gas pressurization, shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.

2.5.4.5 Sample Handling and Analysis. All samples will be analyzed on-site immediately after they are obtained. All chromatograms and field notes will be retained and handled in accordance with the DMP and QAPP. Results will be plotted on a copy of the operable unit base map for interpretation.

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3.0 PHASE I RI TASK 2 - GEOLOGICAL INVESTIGATION

In general, sufficient information exists to characterize the geology of the operable unit and its surroundings. This task consists of a current literature search and an electromagnetic survey. The results will be used to refine the current knowledge on the area geology. In addition to this information, new geological data obtained during the implementation of the soil investigation and the 300-FF-5 groundwater investigation will be evaluated and incorporated into the RI/FS under Task 8b.

3.1 TASK 2A - GEOLOGICAL DATA COMPILATION

This subtask does not involve any field sampling.

3.2 TASK 2B - ELECTROMAGNETIC SURVEY

3.2.1 Sampling Objectives

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The purpose of this subtask is to further define the location and structure of the paleolevee, in the upper portion of the middle Ringold, which lies along the Columbia River. This structure of somewhat lower conductivity sediments appears to have a significant influence on groundwater flow directions in the 300 Area.

3.2.2 Sample Locations and Frequencies

The exact location of the paleolevee is unknown, but previous investigations indicate that it lies parallel and close to the river (Figure 2-7 of the work plan). The survey will be performed one time, on a 30 m (100 ft) grid, along the river within the boundaries of the operable unit.

3.2.3 Sample Designations

A 30 m (100 ft) grid system will be established along the Columbia River over the suspected location of the paleolevee. The grid coordinates will be designated 1, 2, 3, ... along the length of the river, and A, B, C, ... along the base of the grid. Each point within the coordinate system will therefore be designated 1A, 1B, 1C, etc.

3.2.4 Sampling Equipment and Procedures

Details on electromagnetic sampling equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.

3.2.5 Sample Handling and Analysis

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Data gathered will be recorded in a field notebook. All field data will be handled in accordance with QAPP and DMP procedures.

4.0 PHASE I RI TASK 3 - SOIL INVESTIGATION

The purpose of this task is to further define the known vertical extent of soil contamination below hazardous waste disposal facilities in 300-FF-1. Investigation of horizontal contaminant extent will also be performed. The nature of the soil contamination will be verified. Because of logistical factors, the nature of source contamination within burial grounds #4 and #5 will be determined under the soil investigation.

4.1 TASK 3A - SURFACE RADIATION SURVEY

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4.1.1 Task 3a-1 - Surface Radiation Sampling and Analysis

- 4.1.1.1 Sampling Objectives. The purpose of this activity is to locate any areas of contaminated soil outside the facility boundaries of the south and north process ponds. A survey will also be performed on the surfaces of burial grounds #4 and #5. Background surface radiation conditions will also be determined so that meaningful comparisons can be made to the data obtained in the potentially impacted areas. Impacted areas found under this activity will be further characterized through soil borehole sampling in Task 3b.
- 4.1.1.2 Sample Locations and Frequencies. This sampling activity will be a one time occurrence, and will be conducted around the perimeters of both the south and north ponds. The area east of the south pond to the Columbia River will also be sampled under this activity. In addition, a background plot will be sampled to determine operable unit background conditions. These locations are shown in Figure 4-1.

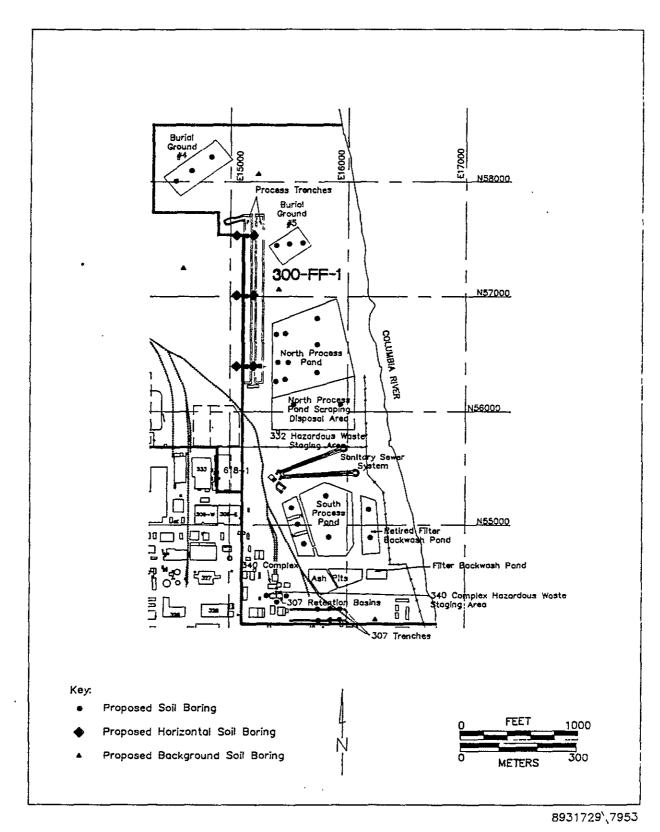
Sampling at the background plot will be conducted at intersecting points on a 7.6 m (25 ft) grid to obtain discrete readings at each point.

Around the process ponds, sampling will be conducted along transects at the edge of the ponds at will be proceed outward at a minimum of 7.6 m (25 ft) intervals until background conditions are encountered. The entire area between the south process pond and the river will be sampled along transects that parallel the east pond boundary and the river. These transects will be spaced no more than 7.6 m (25 ft) apart.

When an elevated level of radiation is encountered while sampling along the transects referred to in the preceding paragraph, the survey will depart from the transect to locate and quantify the source of the reading.

4.1.1.3 Sample Designations. The grid coordinates established for the background plot will be designated A, B, C, ... along the length of the plot, and 1, 2, 3, ... along the width of the plot. Each plot point sampled will be designated by the combined grid coordinates (e.g., B2, C1, etc.).

Points within the potentially impacted areas which are determined to have elevated levels of radiation will be staked for subsequent locational surveying.



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Figure 4-1. Soil Boring Locations

4.1.1.4 Sampling Equipment and Procedures. This survey will be conducted with portable detectors for alpha, beta, and gamma radiation. Discrete background values will be statistically analyzed to find the upper 95% confidence limits of the distribution of background readings. Any values above these limits in the potentially impacted areas will be recorded, and the source locations staked for subsequent geodetic survey under Task 3a-2.

Details on surface radiation equipment and procedures--for alpha, beta, and gamma radiation--shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.

4.1.1.5 Sample Handling and Analysis. Field readings will be recorded in a field notebook and handled in accordance with the DMP and QAPP. Analysis of the data will consist of plotting the results, along with the locations of the readings, on a version of the topographic base map for the operable unit.

4.1.2 Task 3a-2 - Geodetic Survey

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- 4.1.2.1 Sampling Objectives. The two goals of this activity are:
 - to establish a sampling grid in the background plot; and
 - to determine and record the staked locations of elevated radiation readings in the potentially impacted areas.

All surveying for this project will be tied into the Hanford Site coordinate system.

- 4.1.2.2 Sample Locations and Frequencies. The background grid and potentially impacted areas will be surveyed one time. The background grid will be established such that a minimum of 30 discrete intersecting sampling points are created. Areas in the potentially impacted zone that are staked, thus indicating the presence of elevated radioactivity, will be surveyed in.
- 4.1.2.3 Sample Designations. Not applicable.
- **4.1.2.4 Sampling Equipment and Procedures.** Details on surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- **4.1.2.5** Sample Handling and Analysis. Field data will be recorded on-site in a field notebook and handled in accordance with the DMP and QAPP. Analysis of the data will consist of plotting the locations of the background plot and the elevated radiation readings on a copy of the operable unit topographic base map.

4.2 TASK 3B - SOIL SAMPLING AND ANALYSIS

4.2.1 Task 3b-1 - Mobilization

This activity does not involve any field sampling.

4.2.2 Task 3b-2 - Soil Sampling

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4.2.2.1 Sampling Objectives. The objectives of this activity are to:

- confirm, or in some cases determine, the nature of the contaminants present in the soils beneath and near 300-FF-1 specific waste facilities;
- determine the nature of the contaminants within the fill material in burial grounds #4 and #5;
- determine the vertical distribution of contamination within the soils beneath specific waste facilities;
- determine the horizontal distribution of contamination within the soils next to the process trenches;
- determine physical characteristics of the soils; and
- archive samples for potential future analytical purposes, including leach testing.

Results of the horizontal contaminant distribution characterization for the process trenches will be regarded as analogous for the other process liquid disposal facilities in the operable unit (i.e., the north and south ponds and the 307 trenches).

- **4.2.2.2 Sample Locations and Frequencies.** Vertical soil borings will be located within the following 300-FF-1 facilities:
 - the south process pond;
 - the north process pond;
 - the 307 trenches;
 - the 307 retention basins;
 - the process trenches;
 - burial ground #4; and
 - burial ground #5.

Four operable unit background boreholes will also be sampled. Locations for these boreholes are shown in Figure 4-1. The boreholes allocated to burial grounds #4 and #5 will probably be relocated upon completion of the ground penetrating radar survey (Task 1b) or the surface radiation survey (Task 3a-1), because additional information will be available at that time. Figure 4-1 also shows the locations of the three horizontal borings to be installed in the process trenches.

Additional boreholes may be located along the process sewer, along the retired radioactive sewer, the perimeters of the south and north process ponds, and the area between the south pond and the river. The decisions to locate boreholes in these areas, the number of boreholes to be installed, and where to install them will be made upon completion of the electromagnetic, soil tracer gas, and surface radiation surveys (Tasks lc, le, and 3a, respectively). Therefore, these locations are not now indicated on Figure 4-1.

Boreholes will be continuously logged by the on-site geologist. Each will be continuously sampled and analyzed for alpha, beta, and gamma radiation and volatile organic compounds with hand-held field instruments. Samples obtained for laboratory contaminant and physical properties analyses will be similarly screened. Density measurements will be obtained during drive sampling.

Drive samples will be obtained in the vertical borings for laboratory contaminant and physical analysis. Core samples will be obtained at the surface at each boring location and at least every 1.5 m (5 ft) depth increment to a total depth of about 3 m (10 ft) below the level of the natural mean water table. The core sampling interval for the background borings will be 1.5 m (5 ft). Core samples will also be obtained at changes in lithology, the interfaces between the fill material and the subsoil beneath burial grounds #4 and #5, and at any zones where obvious contamination is encountered, as determined by field screening results or visual observation.

To account for potential rapid vertical attenuation of contaminant concentrations, the core sampling interval will generally be decreased to 0.5 m (1.5 ft) in the upper 1.8 m (6 ft) for the process liquid disposal facility basins, except for the 307 trenches, which have been backfilled after being deactivated. In these trenches samples will be obtained at intervals of 0.5 m (1.5 ft) to a depth of 1.8 m (6 ft) below the fill.

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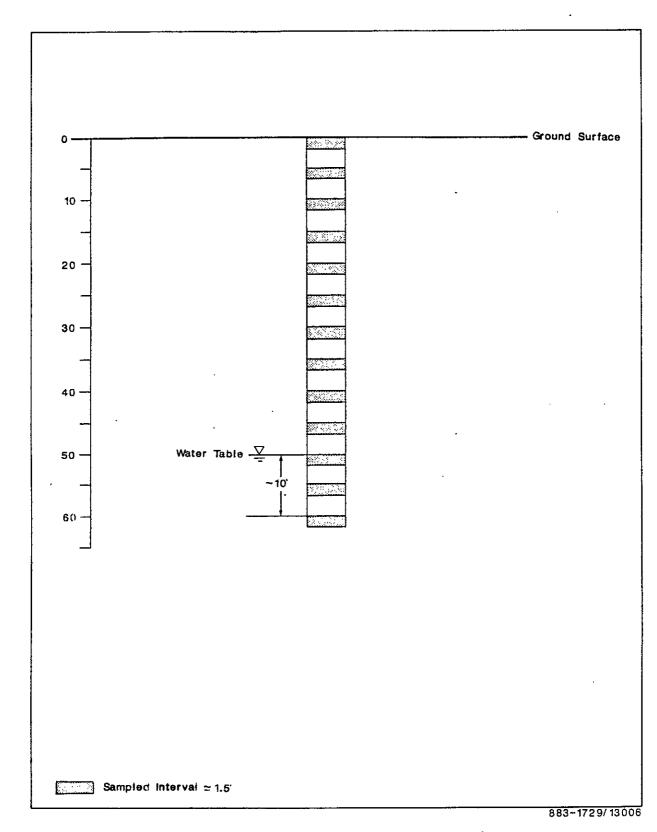
One core sample per geologic stratum per vertical boring will be obtained for physical laboratory analysis. These samples will be randomly allocated with depth prior to initiating drilling. Because the soil borings are expected to be entirely within the Pasco Gravels of the Hanford Formation, one physical core sample per borehole is anticipated.

Core samples will be obtained in the six horizontal process trench borings for laboratory contaminant analysis only. Samples will be taken at the sidewall surface, and at 0.3 m (1 ft) intervals to a distance of 0.9 m (3 ft). This amounts to a total of four core samples per horizontal boring. Additional samples may be taken if zones of obvious contamination are encountered, as determined by field screening or visual observation. Because the process trench sidewalls are sloped, these borings will be installed just below the mean water level, as indicated by vegetation growth.

Figures 4-2 through 4-4 respectively show the vertical core sampling schemes for the: background borings; the south and north ponds, 307 retention basins, process trenches, and borings that may have to be installed in areas shown to be contaminated in the surface radiation survey; and the 307 trenches and borings that may have to be installed along buried pipelines.

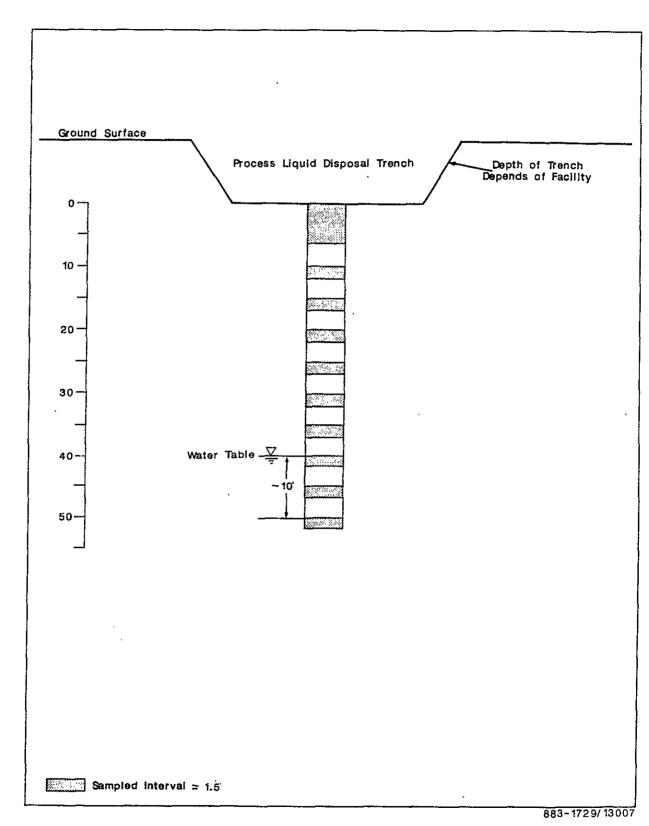
Each time a core sample is obtained, a duplicate archive sample will also be obtained. In addition, duplicate quality assurance samples for laboratory analysis will be taken at a frequency of no less than 5%.

Each vertical and horizontal borehole will be sampled one time prior to being abandoned under Task 3b-5. The archived samples, however, will provide a supply of documented material for additional analytical work, if such work becomes necessary.



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Figure 4-2. Background Soil Borings-Sample Locations



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Figure 4-3. Soil Borings in Process Liquid Disposal Facilities-Sample Locations

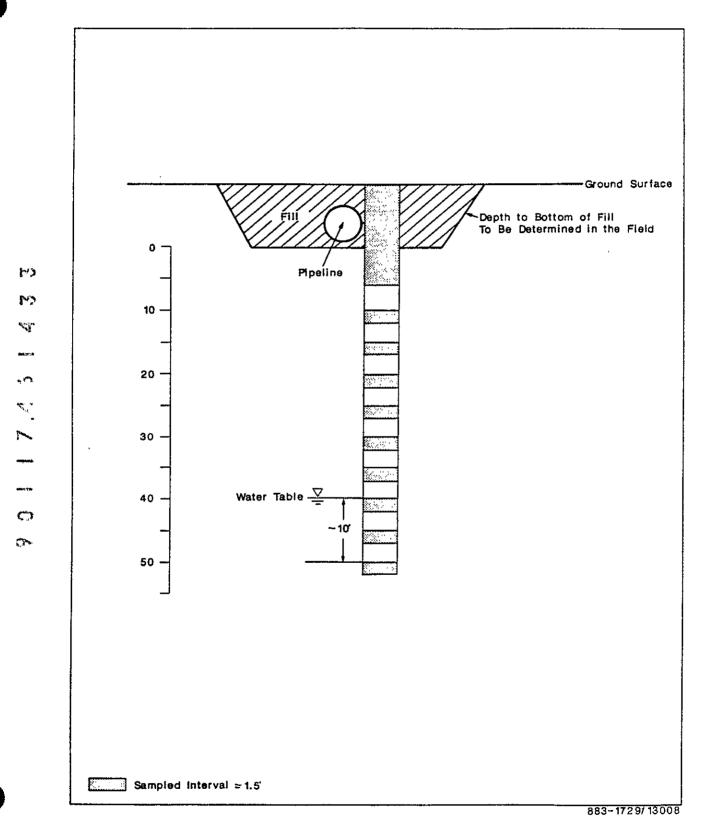


Figure 4-4. Soil Borings in 307 Trenches and at Pipeline Leak Locations-Sample Locations

4.2.2.3 Sample Designations. The following codes will be used to designate samples (X is a variable number):

boring orientation --

- V vertical boring; or
- H horizontal boring.

facility association --

- SPX south process pond;
- NPX north process pond;
- 307TX 307 trenches:
- 307RBX 307 retention basins;
- PTX process trenches; BG4X burial ground #4;
- BG5X burial ground #5;
- PSX process sewer; or
- RRSX retired radioactive sewer.

depth or horizontal penetration --

XX.X - to the nearest tenth of a foot.

disposition (the number 2 will be appended for duplicate samples) --

- MS metals and radiation analyses;
- AS non-metallic ion analysis;
- VS volatile organics analysis;
- TS physical analysis; or
- R archive.

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These codes will be combined to provide such designations as:

- VSP2-10.2-VS2 (a duplicate volatile organics sample obtained from vertical south process pond boring #2, at a depth of 10.2 ft below ground surface); and
- HPT4-3.0-MS (a non-duplicated metals and radiation sample obtained from horizontal boring #4 in the process trenches, 3.0 ft in from the sidewall).
- 4.2.2.4 Sampling Equipment and Procedures. All vertical and horizontal borings will be drilled, all samples obtained, and all field analyses performed in accordance with the procedures and equipment specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP. For vertical borings, cable tool will be the drilling method used. During coring, in the event of drive sample refusal, cuttings will be collected for analysis. Horizontal borings will be hand augered.

Access to the process trenches bottoms will be provided by bulldozing ramps at the north ends of each trench. A protective covering of clean fill material will be provided at each boring location in the trench to minimize contact between the drilling rig, equipment, and crew and the underlying soil. Planking will also be provided along the trench bottoms to allow the drill rig

and crew to move along the trenches with a minimum of contaminant contact and transport.

4.2.2.5 Sample Handling and Analysis. Borehole logs and field logs will be maintained for each boring and all related observations. These logs will be handled in accordance with records procedures specified in the DMP and the QAPP.

Field analyses will include soil density as determined by coring penetration, and contaminant levels as determined by on-site readings of alpha, beta, and gamma radiation, combustible and ionizable organics. Soil density will be determined by penetration during coring. These readings will be recorded in the field log.

Samples for laboratory analysis will be properly preserved and transported-- under chain-of-custody procedures described in the QAPP--to a laboratory. These samples will be analyzed for the physical parameters listed in Table 4-1 or the contaminant parameters listed in Table 4-2.

4.2.3 Task 3b-3 - Soil Sample Analysis

This activity does not involve any field sampling.

4.2.4 Task 3b-4 - Geodetic Survey

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- **4.2.4.1 Sampling Objectives.** The purpose of this activity is to determine the locational coordinates and surface elevations of the borings installed under Task 3b-2. All surveying for this project will be tied into the Hanford Site coordinate system.
- **4.2.4.2 Sample Locations and Frequencies.** Each vertical and horizontal boring installed under Task 3b-2 will be surveyed once.
- 4.2.4.3 Sample Designations. Not applicable.
- **4.2.4.4 Sampling Equipment and Procedures.** The surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- **4.2.4.5** Sample Handling and Analysis. Field data will be recorded on-site in a field notebook and handled in accordance with the DMP and QAPP. Analysis of the data will consist of plotting the locations of the background plot and the elevated radiation readings on a copy of the operable unit topographic base map.

4.2.5 Task 3b-5 - Borehole Abandonment

Table 4-1. Soil Physical Parameters for the 300-FF-1 Operable Unit

permeability
porosity
moisture content
grain size distribution
cation exchange capacity

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Table 4-2. Soil Contaminant Parameters for the 300-FF-1 Operable Unit

```
рΗ
gross alpha
gross beta
gamma scan
aluminum
antimony
beryllium
cadmium
chromium
copper
iron
lead
manganese
mercury
nickel
silver
zinc
ammonium
fluoride
nitrate
nitrite
arochlor 1248
trans-1,2-dichloroethylene methylene chloride
tetrachloroethylene
trichloroethylene
uranium-235
uranium-238
```

X.O PHASE I RI TASK X - GROUNDWATER INVESTIGATION

The purpose of this task is to verify the nature of groundwater contamination attributable to the operable unit, and to further define the extent of such contamination.

X.1 TASK XA - HYDROGEOLOGICAL DATA COMPILATION

This subtask does not involve any field sampling.

- X.2 TASK XB MONITORING WELL AND GAGING STATION INSTALLATION
- X.2.1 Task Xb-1 Mobilization

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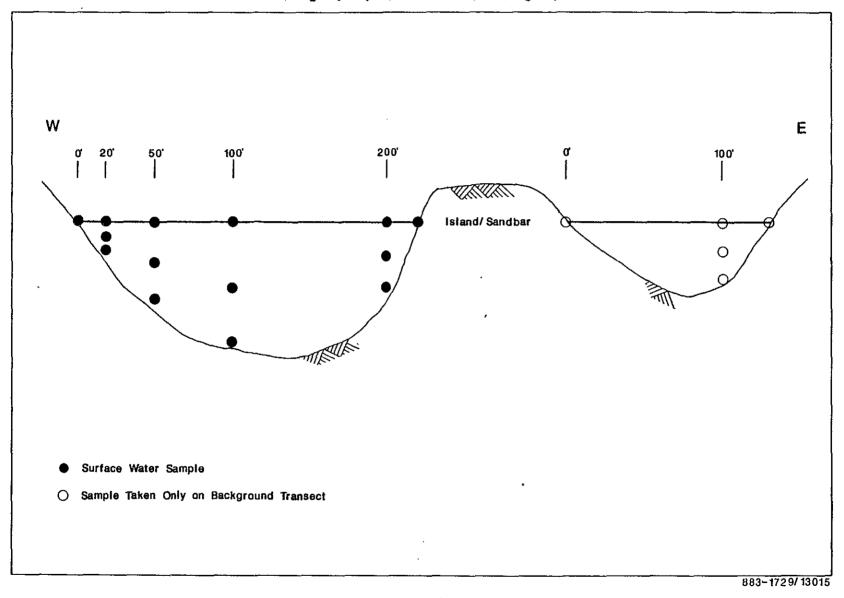
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This activity does not involve any field sampling.

- X.2.2 Task Xb-2 Drilling, Soil Sampling, and Well and Gaging Station Installation
- X.2.2.1 Sampling Objectives. The purpose of the sampling in this task is to characterize soil types and qualities while installing groundwater monitoring wells and river gaging stations.
- X.2.2.2 Sample Locations and Frequencies. At this time, seven groundwater monitoring wells and two river gaging stations, as shown in Figure X-1, are scheduled for installation during the RI/FS for 300-FF-1. Three of the monitoring wells are to be completed within the shallow groundwater zone, and four in the intermediate zone. During the installation of these wells and the gaging stations, soils will be continuously sampled and analyzed with handheld field screening instruments for radiation and volatile organic compounds.

Core samples for laboratory contaminant analysis will be obtained at the surface, changes in lithology, any zones of apparent contamination, and at intervals no greater than 1.5 m (5 ft). One such core sample per geologic stratum encountered per borehole, randomly allocated by depth within the stratum, will also be obtained for laboratory physical analysis. Soil density will be obtained from coring penetrations, and each well and station will be logged by the on-site geologist. Figure 4-2 shows this vertical soil sampling scheme.

X.2.2.3 Sample Designations. River gaging stations will be identified as either RGS1 or RGS2. Wells will be designated in accordance with the system currently in use at the Hanford Site (McGhan et al., 1985).



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Figure Y-1. Surface Water and River Sediment Transect Sampling Locations

The following codes will be used to designate soil samples obtained under this activity (X is a variable number):

well or gaging station designator --

depth or horizontal penetration--

• XX.X - to the nearest tenth of a foot.

disposition (the number 2 will be appended for duplicate samples) --

- MS metals and radiation analyses;
- AS non-metallic ion analysis;
- VS volatile organics analysis;
- TS physical analysis; or
- R archive.

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These codes will be combined to provide such designations as:

- (well designator)-15.0-MS; or
- RGS1-5.0-VS2.
- X.2.2.4 Sampling Equipment and Procedures. All drilling, sampling, field screening analyses, and installations shall be performed in accordance with approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- X.2.2.5 Sample Handling and Analysis. The on-site geologist will maintain a field log and a well log for each installation. These logs will be handled in accordance with procedures specified in the DMP and QAPP.

On-site analyses will be performed for combustible organics, ionizable organics, and alpha, beta, and gamma radiation. Soil density, as determined by coring penetration, will also be recorded. Such on-site readings will be recorded in the field log.

Samples for laboratory analysis will be properly preserved and transported--under chain-of-custody procedures described in the QAPP--to a laboratory. These samples will be analyzed for the physical parameters listed in Table 4-1 or the contaminant parameters listed in Table 4-2.

X.2.3 Task Xb-3 - Soil Sample Analysis

This activity does not involve any field sampling.

X.2.4 Task Xb-4 - Geodetic Survey

X.2.4.1 Sampling Objectives. This activity entails the determination of the locational coordinates and elevations of each of the wells and gaging stations installed under Task Xb-2. All surveying for this project will be tied into the Hanford Site coordinate system.

- X.2.4.2 Sampling Locations and Frequencies. Each of the seven groundwater monitoring wells and the two river gaging stations installed under Task Xb-2 will be surveyed once.
- X.2.4.3 Sample Designations. Not applicable.
- X.2.4.4 Sampling Equipment and Procedures. All surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- X.2.4.5 Sample Handling and Analysis. Data will be recorded in a field notebook which will be handled in accordance with the DMP and OAPP.
- X.3 TASK XC GROUNDWATER SAMPLING AND ANALYSIS
- X.3.1 Task Xc-1 Groundwater Sampling

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- X.3.1.1 Sampling Objectives. The purpose of this activity is to allow for a better determination of the extent of groundwater contamination attributable to the operable unit. This activity will also serve to confirm the nature of such contamination.
- X.3.1.2 Sample Locations and Frequencies. All groundwater monitoring wells, newly installed under Task Xb-2 will be sampled quarterly for a period of one year during this project. The sampling of existing wells within the operable unit, as well as those wells outside the operable unit to be included in the groundwater investigation (as determined under Task Xa), will also be incorporated into this schedule. Duplicate samples and on-site analyses will be obtained at a frequency no less than 10%.
- **X.3.1.3 Sample Designations.** Groundwater samples will be designated by the well code and the intended disposition of the sample. Disposition codes are (the number 2 will be appended for duplicate samples):
  - MS metals and radiation analyses;
  - AS non-metallic ion analysis;
  - VS volatile organics analysis; or
  - R archive.

These codes will be combined to provide such designations as:

- (well code)-MS; or
- (well code)-VS2.
- **X.3.1.4 Sampling Equipment and Procedures.** All groundwater sampling equipment and procedures used for this activity shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- X.3.1.5 Sample Handling and Analysis. Several parameters will be measured immediately on-site: static water level, water temperature, pH, and specific conductivity. These measurements will be performed in accordance with

approved procedures. Results will be recorded in a field notebook which will be handles in accordance with procedures specified in the QAPP and DMP.

Samples obtained for laboratory analysis will be properly preserved and transported to the designated laboratory. Such samples will be analyzed for the parameters listed in Table X-1. Chain-of-custody procedures, as described in the QAPP, will be followed.

X.3.2 Task Xc-2 - Groundwater Sample Analysis

This activity does not involve any field sampling.

- X.4 TASK XD GROUNDWATER/SURFACE WATER INTERACTIONS
- X.4.1 Task Xd-1 Mobilization

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This activity does not involve any field sampling.

- X.4.2 Task Xd-2 Monitoring Well and Gaging Station Recorder Installation
- X.4.2.1 Sampling Objectives. The purpose of this activity is to install continuous recorders to obtain representative measurements of static water level, water temperature, specific conductivity, and gross alpha, beta, and gamma radiation in select groundwater monitoring wells and the two river gaging stations installed under Task Xb-2.
- X.4.2.2 Sample Locations and Frequencies. Recording instruments will be installed once, followed by ongoing maintenance under Task Xd-3. Besides the two river gaging stations, the instruments will be installed in the following groundwater monitoring wells:
  - shallow groundwater zone--

3-1-6,

3-1-10,

3-1-17A,

3-1-16A.

3-3-12, and

3-3-9; and

• intermediate groundwater zone--

3-1-17B, and

3-1-16B.

These wells lie along three cross-sections parallel to the Columbia River (see Figure X-1).

**Table X-1.** Groundwater Contaminant Parameters for the 300-FF-1 Operable Unit

рΗ gross alpha gross beta gamma scan aluminum antimony beryllium | cadmium chromium copper iron 1ead manganese mercury nickel . silver zinc ammonium fluoride nitrate nitrite arochlor 1248 trans-1,2-dichloroethylene methylene chloride tetrachloroethylene trichloroethylene uranium-235 uranium-238

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- X.4.2.3 Sample Designations. Not applicable.
- **X.4.2.4 Sampling Equipment and Procedures.** The equipment and procedures used to install the well/gaging station recorders shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- X.4.2.5 Sample Handling and Analysis. Field notes will be maintained during installation and the notebook will be handled in accordance with the DMP and QAPP.
- X.4.3 Task Xd-3 Data Collection and Recorder Maintenance
- X.4.3.1 Sampling Objectives. The purpose of this activity is twofold:
  - o to collect the continuously recorded water level, temperature, conductivity, and radiation data in the river gaging stations and selected groundwater monitoring wells; and
  - o to maintain the operational status of the recording instruments to ensure the quality of the data obtained.
- X.4.3.2 Sample Locations and Frequencies. The locations for this activity are the same as those specified under Task Xd-2. The frequency of data collection and recorder maintenance will be dependent on the operational requirements of the instruments selected for this activity under Task Xd-1.
- X.4.3.3 Sample Designations. Recording charts will be designated by the appropriate well or river gaging station code and sampled time period.
- **X.4.3.4 Sampling Equipment and Procedures.** The equipment and procedures used to collect recorder data and maintain the recording instruments shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- **X.4.3.5** Sample Handling and Analysis. The recording instrumentation will collect continuous information on static water levels, specific conductivity, water temperature, and alpha, beta, and gamma radiation. Periodic calibration of these instruments will be required. All field notes, maintenance logs, and recorder charts shall be handled in accordance with the DMP and QAPP.

#### X.4.4 Task Xd-4 - Aguifer Tests

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- **X.4.4.1 Sampling Objectives.** The objectives of this activity are to determine hydraulic conditions in the uppermost three groundwater zones at the operable unit and to supplement aquifer pressure condition data obtained under Tasks 4c-1 and 4d-3 by collecting additional static water level readings in those wells without continuous water level recorders.
- X.4.4.2 Sample Locations and Frequencies. Upon completion of Task Xa, a hydrogeologist will decide which wells hydraulic tests (slug tests and/or pump tests) will be performed upon. Hydraulic testing will be performed one time only on each well selected, except in the event that an initial slug test on a

particular well is deemed inadequate. In this case, a follow-up pump test may be conducted.

Supplemental static water level readings will be performed on all wells included in the 300-FF-1 groundwater investigation, as determined under Task Xa, except for those eight which will have continuous water level recorders installed. These eight wells are listed under Chapter X.4.2.2 of this plan.

- X.4.4.3 Sample Designations. Each aquifer test will be designated by the respective well code for the well on which the test is performed.
- **X.4.4.4 Sampling Equipment and Procedures.** The slug test, pump test, and water level measurement equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.

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**X.4.4.5** Sample Handling and Analysis. The hydrogeologist performing the aquifer tests will maintain a field notebook and handle the data generated in accordance with the DMP and QAPP.

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#### Y.O PHASE I RI TASK Y - SURFACE WATER AND SEDIMENT INVESTIGATION

This task was established to characterize the nature and extent of contamination in the surface waters and sediments of the Columbia River, alongside and immediately downstream of the 300 Area.

#### Y.1 TASK YA - HYDROLOGICAL DATA COMPILATION

This subtask does not involve any field sampling.

#### Y.2 TASK YB - RIVER BANK SURVEY

#### Y.2.1 Task Yb-1 - Bank Reconnaissance

- Y.2.1.1 Sampling Objectives. The purpose of this activity is to locate seeps from the operable unit into the Columbia River and estimate their relative flow volumes to determine whether or not a preferential groundwater discharge pathway exists.
- Y.2.1.2 Sample Locations and Frequencies. This reconnaissance will be performed once during low river stage so that all seeps can be observed. The survey will occur along that portion of the bank of the Columbia River that is immediately adjacent to the 300 Area.
- Y.2.1.3 Sample Designations. Each seep encountered will be numbered SP1, SP2, SP3, ..., with the first seep being the one located furthest upstream within the operable unit boundary.
- Y.2.1.4 Sampling Equipment and Procedures. All equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP. All seeps will be marked with stakes to allow for the geodetic survey under Task Yb-4.
- Y.2.1.5 Sample Handling and Analysis. Field notes will be maintained and handled in accordance with procedures described in the QAPP and DMP.

#### Y.2.2 Task Yb-2 - Seep Sampling

- Y.2.2.1 Sampling Objectives. The objective of the seep sampling is to determine the quality of the discharged groundwater and to see if there are any changes in quality along the river bank. If such changes are found, a preferential groundwater contaminant transport pathway may exist at the 300 Area.
- Y.2.2.2 Sample Locations and Frequencies. This is a one time sampling event. The exact locations from which samples will be obtained will be determined based upon the results of Task Yb-1.

- **Y.2.2.3 Sample Designations.** Each sample will be designated by the seep code and intended sample disposition. Disposition codes are (2 will be appended for duplicate samples):
  - MS metals and radiation analyses;
  - AS non-metallic ion analysis;
  - VS volatile organics analysis;
  - R archive.

Codes will be combined in the following manner:

- SPI-MS; or
- SP3-AS2.

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- Y.2.2.4 Sampling Equipment and Procedures. All equipment and procedures used to obtain the water samples shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- Y.2.2.5 Sample Handling and Analysis. Parameters measured in the field will be water temperature, water pH, and specific conductivity of the water. These values will be determined in accordance with approved procedures, and recorded in a field notebook which will be handled in accordance with procedures described in the QAPP and DMP. Both filtered and unfiltered metals samples will be obtained. All such filtration will be performed in the field.

Samples obtained for further analysis will be properly preserved and transported--under chain-of-custody procedures described in the QAPP--to the designated laboratory. Water samples will be analyzed for the groundwater parameters listed in Table Y-1. In addition total suspended solids (TSS) samples will be obtained. Sediment samples will be analyzed for the soil parameters listed in Table X-2.

#### Y.2.3 Task Yb-3 - Seep Sample Analysis

This activity does not involve any field sampling.

#### Y.2.4 Task Yb-4 - Geodetic Survey

- **Y.2.4.1 Sampling Objectives.** This activity will determine the locational coordinates and elevations of the seeps found under Task Yb-1. All surveying for this project will be tied into the Hanford Site coordinate system.
- Y.2.4.2 Sample Locations and Frequencies. The seeps into the Columbia River, along the bank of the operable unit, will be surveyed once.
- Y.2.4.3 Sample Designations. Not applicable.
- **Y.2.4.4 Sampling Equipment and Procedures.** Surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.

- Y.2.4.5 Sample Handling and Analysis. All field notes will be maintained in accordance with the DMP and QAPP.
- Y.3 TASK YC SURFACE WATER AND SEDIMENT SAMPLING AND ANALYSIS
- Y.3.1 Task Yc-1 Geodetic Survey

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Y.3.1.1 Sampling Objectives. The objective of the first portion of this activity is to locate and stake the positions of the 1,000 ft (305 m) E-W coordinate lines where they intersect the Columbia River bank above, along, and below the operable unit. These locations will be used to demarcate near-shore sampling stations under Task Yc-2 and transect lines across the river for Task Yc-4. All surveying for this project will be tied into the Hanford Site coordinate system.

The second phase of this activity involves the determination of actual sampling locations during the river transect sampling to be performed under Task Yc-4.

Y.3.1.2 Sample Locations and Frequencies. Both portions of this activity will be one-time occurrences. The first portion will locate and stake the position where coordinate line N59000 intersects the Columbia River bank just upstream of the operable unit. Each point downstream, along and below the operable unit, where 1,000 ft (305 m) coordinate lines intersect the river bank will also be identified. This will be done at 1,000 ft (305 m) intervals down to coordinate line N51000.

The second portion of this activity will involve determining, through geodetic survey from the river bank, the actual points sampled along transect lines established across the river under Task Yc-4. These transects will be located at 2,000 ft (610 m) intervals along the bank at points identified during the first phase of this activity. Survey equipment will be set up so as to determine the sampling locations along the transect with respect to distance from shore and any deviation in distance above or below the actual transect.

- Y.3.1.3 Sample Designations. Not applicable.
- Y.3.1.4 Sampling Equipment and Procedures. Surveying equipment and procedures shall be specified in approved participant contractor, or subcontractor procedures, as described in the QAPP. Third order precision and accuracy will be required.
- Y.3.1.5 Sample Handling and Analysis. Each 1,000 ft (305 m) coordinate located along the bank of the Columbia River under the first portion of this activity will be staked. WHC will undertake administrative measures to ensure that these stakes are not disturbed during the project.

A field notebook will be maintained during this activity and the data will be handled in accordance with the DMP and QAPP.

# Y.3.2 Task Yc-2 - Near-Shore Surface Water and Sediment Sampling

- Y.3.2.1 Sampling Objectives. The two objectives of this activity are:
  - o to determine the contaminants of concern for the surface water and river sediment media; and
  - o to determine the longitudinal extent of the contaminant plume within the river water column and the longitudinal extent of sediment contamination.
- Y.3.2.2 Sample Locations and Frequencies. This one-time sampling event will take place above, along, and below the operable unit at the shore of the west bank of the Columbia River. This event will take place during low river stage to characterize worst-case conditions.

An upgradient background station will be sampled where coordinate line N59000 intersects the river. Four samples will be taken at this station over the course of the period used to collect all samples for this activity. One background sample will be obtained at the beginning of the sampling period, one at the end, and two others separated at approximately equal time intervals.

Downgradient samples will be obtained at 305 m (1,000 ft) intervals, as staked out under Task Yc-1, down to coordinate line N51000, or further, if field screening results indicate that contaminants are still present at this location.

- Y.3.2.3 Sample Designations. Each sample will be designated by the coordinate line which establishes the sampling point and the intended sample disposition. Disposition codes are (2 will be appended for duplicate samples):
  - MS metals and radiation analyses;
  - AS non-metallic ion analysis;
  - VS volatile organics analysis;
  - R archive.

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Water samples will be prefaced with W; sediment samples with S. Codes will be combined in the following manner:

- W-N59000-MS; or
- S-N57000-AS2.
- **Y.3.2.4 Sampling Equipment and Procedures.** All water and sediment sampling equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- Y.3.2.5 Sample Handling and Analysis. Parameters measured in the field will be water temperature, water pH, and specific conductivity of the water. These values will be determined in accordance with approved procedures and recorded in a field notebook, which will be handled in accordance with procedures described in the QAPP and DMP. Both filtered and unfiltered metals samples will be obtained. All such filtration will be performed in the field.

Samples obtained for further analysis will be properly preserved and transported--under chain-of-custody procedures described in the QAPP--to the designated laboratory. Water samples will be analyzed for groundwater parameters listed in Table Y-1. In addition total suspended solids (TSS) samples will be obtained. Sediment samples will be analyzed for the soil parameters listed in Table X-2.

# Y.3.3 Task Yc-3 - Near-Shore Surface Water and Sediment Sample Analysis

This activity does not involve any field sampling.

Y.3.4 Task Yc-4 - Surface Water Transect Sampling

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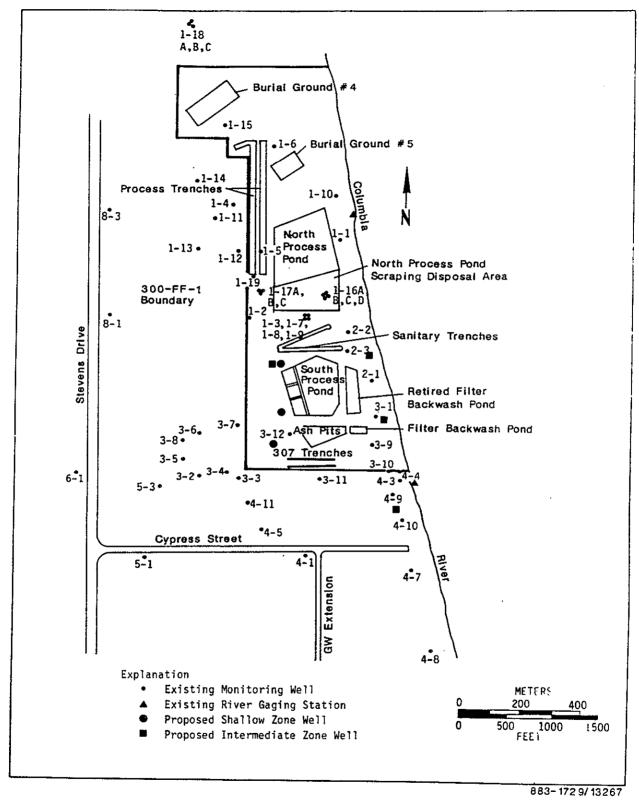
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- Y.3.4.1 Sampling Objectives. The objective of this activity is:
  - o to determine the three dimensional extent of the contaminant plume, attributable to the 300 Area, in the Columbia River water column.
- Y.3.4.2 Sample Locations and Frequencies. Each transect will be sampled one-time. Transects will be established across the river, perpendicular to the channel, with the western base of the transects located at coordinate lines N59000, N57000, N55000, N53000, and N51000. Additional transects will be established further downstream if the results of Tasks Yc-2 and Yc-3 indicate such a need.

The first sampling station in each transect will be at the shore adjacent to 300-FF-1. Additional sampling stations will be at 6, 15, and 30 m (20, 50, and 100 ft) from shore, and from there at 30 m (100 ft) intervals until an island (sandbar) or the opposite side of the river is reached. The final sampling station will be at the island or opposite shore. Additional sample stations will be included on the background transect. These will include stations on the far (eastern) shore of the island, on the opposite bank of the river, and at 90 m (300 ft) intervals between the island and the opposite shore.

Water samples will be obtained at each sampling station from the river's surface, half-way to the bottom, and 1.5 m (5 ft) off the bottom. One river bottom sediment sample will be taken at each station. Depth to bottom will be measured with an acoustic depth sounder or sounding line, whichever is more practical at the particular location. The surface water transect sampling scheme is shown on Figure Y-1.

- **Y.3.4.3 Sample Designations.** Each sample will be designated by the coordinate line which establishes the transect, the distance from the west bank, and the intended sample disposition. Disposition codes are (2 will be appended for duplicate samples):
  - MS metals and radiation analyses;
  - AS non-metallic ion analysis;
  - VS volatile organics analysis;
  - R archive.



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Figure X-1. Proposed Monitoring Well Locations

Water samples will be prefaced with W, and will indicate distance from shore and depth of the sample in the format, distance/depth, in feet.

Codes will be combined in the following manner:

W-N59000-100/0-MS.

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- Y.3.4.4 Sampling Equipment and Procedures. All water sampling equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- Y.3.4.5 Sample Handling and Analysis. Parameters measured in the field will be water temperature, water pH, and specific conductivity of the water. These values will be determined in accordance with approved procedures and recorded in a field notebook, which will be handled in accordance with procedures described in the QAPP and DMP. Both filtered and unfiltered metals samples will be obtained. All such filtration will be performed in the field.

Samples obtained for further analysis will be properly preserved and transported--under chain-of-custody procedures described in the QAPP--to the designated laboratory. Water samples will be analyzed for parameters to be determined on the basis of the results of Task Yc-3.

Y.3.5 Task Yc-5 - Surface Water Transect Sample Analysis

- Y.4 TASK YD DRINKING WATER SAMPLING AND ANALYSIS
- Y.4.1 Task Yd-1 Drinking Water Sampling
- **Y.4.1.1 Sampling Objectives.** The objective of this activity is to obtain samples to allow for the determination of the quality of the drinking water drawn from the Columbia River at the 300 Area and the City of Richland.
- **Y.4.1.2 Sample Locations and Frequencies.** Three replicate samples will be obtained from each of the water supply systems one time during low river stage to characterized worst-case conditions. The sampling locations will be at the first accessible tap, dispensing treated water, beyond each water treatment plant.
- **Y.4.1.3 Sample Designations.** Samples from the 300 Area will be designated 300; from the City of Richland, COR. Sample disposition will also be included (2 will be appended for duplicate samples):
  - MS metals and radiation analyses;
  - AS non-metallic ion analysis;
  - VS volatile organics analysis;
  - R archive.

Codes will be combined as follows:

- 300-MS; or
- COR-AS2.

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- **Y.4.1.4 Sampling Equipment and Procedures.** All equipment and procedures shall be specified in approved WHC, participant contractor, or subcontractor procedures, as described in the QAPP.
- **Y.4.1.5** Sample Handling and Analysis. Parameters measured on-site will be water temperature, water pH, and specific conductivity of the water. These values will be determined in accordance with approved procedures and recorded in a field notebook, which will be handled in accordance with procedures described in the QAPP and DMP.

Samples obtained for further analysis will be properly preserved and transported--under chain-of-custody procedures described in the QAPP--to the designated laboratory. Samples will be analyzed for parameters to be determined on the basis of the results of the surface water analyses performed under Task Yc-3.

#### Y.4.2 Task Yd-2 - Drinking Water Sample Analysis

#### 5.0 PHASE I RI TASK 4 - AIR INVESTIGATION

This task is designed to compile accessible climatological data needed to perform the FS. It is also meant to expand the existing ambient air monitoring program for the 300 Area to incorporate operable unit-specific contaminants of concern.

#### 5.1 TASK 4A - AIR DATA COMPILATION

This subtask does not involve any field sampling.

#### 5.2 TASK 4B - AMBIENT AIR SAMPLING AND ANALYSIS

#### 5.2.1 Task 4b-1 - Ambient Air Sampling

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- **5.2.1.1 Sampling Objectives.** The goal of this activity is to determine whether or not fugitive dust from the south and north process ponds and the process trenches is impacting air quality in the 300 Area. If such an impact is determined to exist, the further objective is to determine the magnitude of such impact. If an impact is of such magnitude that the short-term consequences are adverse, an expedited response action, such as the application of dust suppressants, will be implemented to abate the problem until a remedy for the operable unit is selected.
- **5.2.1.2 Sample Locations and Frequencies.** Unless otherwise decided under Task 4a, the current ambient air sampling program for the 300 Area will be maintained with respect to sampling locations and frequencies.
- **5.2.1.3 Sample Designations.** No changes to the sample designations now employed under the current ambient air monitoring program for the 300 Area are anticipated, unless otherwise decided under Task 4a.
- **5.2.1.4 Sampling Equipment and Procedures.** Sampling equipment and procedures currently in use for the 300 Area ambient air monitoring program will not be altered unless the need to do so is demonstrated during the implementation of Task 4a.
- 5.2.1.5 Sample Handling and Analysis. Sample handling will be performed in accordance with procedures set forth in the DMP and QAPP. Analyses will remain the same as for the existing monitoring program, except that additional operable unit contaminants of concern, as decided under Task 4a, will be included. Such additional parameters are anticipated to be non-radioactive metals that are known to exist in high concentrations in the soils within the process ponds and trenches (e.g., chromium and copper).

#### 5.2.2 Task 4b-2 - Ambient Air Sample Analysis

#### 6.0 PHASE I RI TASK 5 - BIOLOGICAL INVESTIGATION

This task is designed to evaluate potentially sensitive biological receptors that inhabit the operable unit environment. It is possible that the results of the surface water and sediment investigation, will expand the needs of the task to include additional subtasks to define the nature and extent of biocontamination attributable to the operable unit.

#### 6.1 TASK 5A - TERRESTRIAL BIOLOGICAL SURVEY

- 6.1.1 Task 5a-I Hazardous Substances Biological Uptake Assessment
- 6.1.1.1 Sampling Objectives. The purpose of this activity is to locate any areas of biological disturbance within the operable unit that can be attributed to the uptake of hazardous substances. The impacted species will also be determined.
- **6.1.1.2 Sample Locations and Frequencies.** This activity will consist of a one-time, on-site, visual reconnaissance that will cover the entire surface of the operable unit.
- **6.1.1.3 Sample Designations.** Any areas where evidence of biological uptake of hazardous substances are found will be described by locational coordinates and types of species impacted.
- **6.1.1.4 Sampling Equipment and Procedures.** This assessment will be performed by a biologist having field experience at the Hanford Site. The procedures and equipment are detailed in the QAPP.
- 6.1.1.5 Sample Handling and Analysis. Notes will be maintained in a field notebook and handled in accordance with the DMP and QAPP.

#### 6.1.2 Task 5a-2 - Species Survey

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- **6.1.2.1 Sampling Objectives.** The objective of this survey is to determine what species--that are endangered, threatened, economically important, or constitute significant components of the human food chain--inhabit 300-FF-1. In addition, the use of the operable unit habitat of each such species identified will be characterized to allow for an assessment of potential biological impacts.
- **6.1.2.2 Sample Locations and Frequencies.** This activity will be a one-time, on-site survey performed over the entire surface of the operable unit. The on-site survey will be supplemented with a literature search.
- 6.1.2.3 Sample Designations. Any endangered, threatened, economically important, or significant human food chain constituent species determined to inhabit 300-FF-1 habitat will be described by both common and taxonomic nomenclature. If a given species is determined to inhabit a particular portion of the operable unit habitat, that portion will be described by locational coordinates.

- **6.1.2.4 Sampling Equipment and Procedures.** This survey will be performed by a biologist having field experience at the Hanford Site. Procedures and equipment are described in the QAPP.
- **6.1.2.5** Sample Handling and Analysis. The biologist will maintain notes in a field notebook and handle these in accordance with the DMP and QAPP.

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# 7.0 PHASE I RI TASK 6 - DATA EVALUATION

Data gathered under the above tasks will be evaluated under this task, which does not involve any field sampling.

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# 8.0 PHASE I RI TASK 7 - VERIFICATION OF CONTAMINANT- AND LOCATION-SPECIFIC ARARS

This task is designed to provide a focus on potential ARARs which could function as cleanup standards for the selected remedy. It does not involve any field sampling.

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## 9.0 PHASE I RI TASK 8 - BASELINE RISK ASSESSMENT

Data collected under the first seven tasks will be used to generate a baseline risk assessment for the operable unit. This task does not involve any field sampling.

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# 10.0 PHASE I RI TASK 9 - PHASE I RI REPORT: PRELIMINARY OPERABLE UNIT CHARACTERIZATION SUMMARY

This task, which consists of summarizing the results of Tasks 1 through 7 and whatever portion of the baseline risk assessment is available, does not involve any field sampling.

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## 11.0 REFERENCES

McGhan, V. L., Mitchell, P. J., and Argo, R. S., 1985. <u>Hanford Wells</u>, prepared by Pacific Northwest Laboratory for U.S. Department of Energy, Richland, WA.

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# ATTACHMENT 1b QUALITY ASSURANCE PROJECT PLAN

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#### QUALITY ASSURANCE PROJECT PLAN FOR PHASE 1 ENVIRONMENTAL INVESTIGATIONS IN THE 300-FF-1 OPERABLE UNIT

#### Revision -0-

Westinghouse Hanford Company Environmental Engineering and Technology Function Richland, Washington

| Approved by:                                              |        |
|-----------------------------------------------------------|--------|
| US EPA Unit Manager                                       | Date:_ |
| US EPA QA Officer                                         | Date:_ |
| State of Washington Department of<br>Ecology Unit Manager | Date:  |
| State of Washington Department of<br>Ecology QA Manager   | Date:  |
| US DOE Unit Manager                                       | Date:_ |
| US DOE QA Officer                                         | Date:  |
| Westinghouse Hanford/<br>EE&T Technical Lead:             | Date:_ |
| Wastinghouse Hanford OA Officer.                          | Data.  |

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The following table of contents lists all Quality Assurance Project Plan (QAPP) elements in the format recommended by CERCLA (EPA, 1988c). Appendix A is a glossary of significant technical terms used in the QAPP. Appendix B is a list of the references used in the QAPP text. Appendix C is a collection of recommended statistical methods and formulae that may be used in the development of appropriate analytical procedures.

Distribution of this document shall be controlled as required by standard Westinghouse Hanford procedures. Distribution shall routinely include the reviewers indicated by the approval signatures on the title page and all Field Team Leaders designated by the Technical Lead.

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| Table 4-1  | Sampling and Investigative Procedures for Phase I At1b-10 Investigations in the 300-FF-1 Operable Unit                        |
|            |                                                                                                                               |

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### 1.0 PROJECT DESCRIPTION

### 1.1 PROJECT OBJECTIVE

The primary objective of the environmental investigations in the 300-FF-1 Operable Unit is to further define the extent and location of sources of metallic, inorganic, volatile organic, and radioactive isotope contamination in the vadose zone and underlying aquifers. Data resulting from this investigation will be evaluated to determine the most feasible options for remediation.

### 1.2 BACKGROUND INFORMATION

The 300-FF-1 Operable Unit is located in the northwest corner of the 300 Area of the Hanford Site, as shown on Figure 1-1. Detailed background information regarding the history and present use of the unit is provided in Section 2.0 of the 300-FF-1 Operable Unit Work Plan.

# 1.3 QA PROJECT PLAN SCOPE AND RELATIONSHIP TO WESTINGHOUSE HANFORD ENVIRONMENTAL QA PROGRAM PLAN

This QA Project Plan (QAPP) summarizes the general policies, organization, activities, and methods necessary to achieve Phase I data quality objectives for the 300-FF-1 Operable Unit. It is an element of the Sampling and Analysis Plan (SAP) prepared specifically for this unit investigation, and is prepared in compliance <u>Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Draft)</u> (EPA, 1988) and the overall quality program requirements of the Westinghouse Hanford Company as discussed in Section 1.4 of the work plan. Distribution and revision control of the QAPP will be performed in compliance with standard Westinghouse Hanford procedures. QAPP distribution shall routinely include all review/approval personnel and all other individuals designated by the Westinghouse Hanford Technical Lead. All other plans or procedures referenced in the QAPP are available for regulatory review upon request by the direction of the Technical Lead.

### 1.4 SCHEDULE OF ACTIVITIES

The investigations that will be conducted in the 300-FF-1 operable unit will be subdivided into two or more discrete phases and a number of individual tasks. Since the results of the task activity in an individual phase may significantly affect the technical activities planned for subsequent phases, this QAPP shall undergo mandatory review after completion of each phase and be updated or modified as to accommodate any required revisions in the scope of work. This version of the QAPP applies specifically to Phase 1 of the remedial investigation.

Individual task scopes for Phase 1 are listed and briefly described below; more detailed, comprehensive discussions are contained in Section 5.3 of the unit Work Plan. Procedures applicable to the tasks described here are discussed in Section 4.0 below. All sample analyses will be conducted as described in Section 3.0, Table 3-1, and Section 7.0

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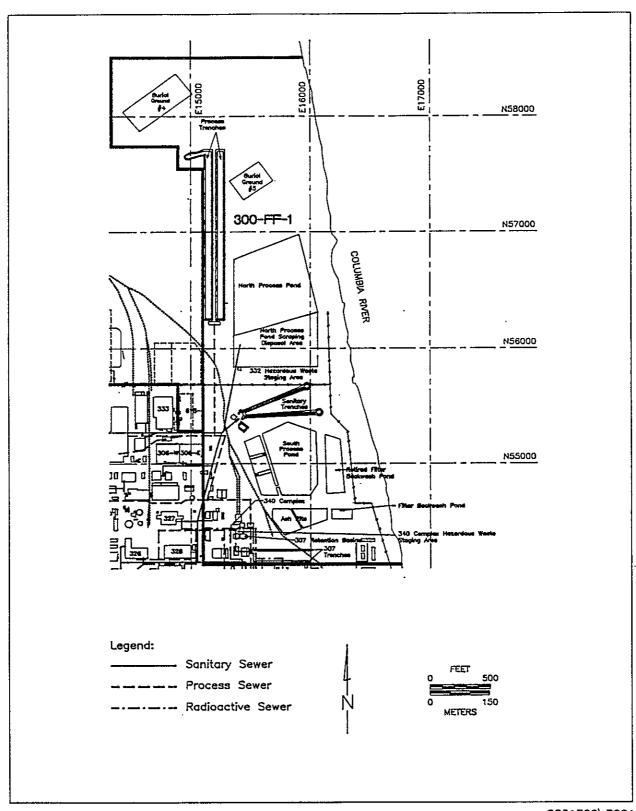


Figure 1-1. Location Map

### Phase I:

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- <u>Task 1: Source Investigation</u>; Task 1 involves gathering additional information on several facilities within the 300-FF-1 Operable Unit. Engineering plans will be reviewed, and geodetic, ground penetrating radar, and electromagnetic surveys will be conducted to better characterize the location of buried objects and structures. Topographical maps will be updated. A tracer gas survey, testing, sampling, and analysis program will be conducted in an attempt to detect leaks within the retired radioactive sewer system.
- <u>Task 2: Geological Investigation</u>; Task 2 will entail a comprehensive literature search and review to collect all pertinent existing geological data related to the 300-FF-1 Operable Unit, as well as an electromagnetic (EM) survey near the Columbia River unit boundary.
- <u>Task 3: Soil Investigation</u>; Task 3 involves surface scintillation surveying, geodetic surveying, subsurface soil sampling, and soil sample analysis.
- Task 4: Groundwater Investigation; Task 4 will require compilation of the hydrogeological data base and preparation of working files. Monitoring wells and river gaging stations will be installed in several locations; well drilling will be accompanied by soil sampling, analysis, and physical testing activities. Newly installed wells and gaging stations will be geodetically surveyed. A groundwater sampling program will be initiated using the monitoring wells and gaging stations. Water level measurements will be recorded, and hydraulic pump tests will be performed on a selected number of wells.
- Task 5: Surface Water and Sediment Investigation; Hydrological data will be collected and compiled. A river bank survey will be conducted, involving reconnaissance, surface (seep) water sampling, analysis, and geodetic surveying. Water and sediments from near the shore and from cross-river transects will be sampled and analyzed. Drinking water supplies will also be sampled.
- <u>Task 6: Air Investigation</u>; Meteorological data will be compiled, and the existing ambient air monitoring program analyzed in order to augment the parameter list for the proposed monitoring program.
- Task 7: Biological Investigation; An evaluation of biota for evidence of toxic uptake and a qualitative species survey will be conducted by qualified biologists; recommendations will be made for appropriate biotic sampling activities in later phases of the investigation.
- <u>Task 8: Data Evaluation</u>; Data from the investigations of Tasks 1 through 6 will be processed, and preliminary recommendations for additional investigations will be made.
- Task 9: Verification of Contaminant- and Location-Specific ARARs; Project staff will verify applicable relevant and appropriate requirements (ARARs) for investigations in the 300-FF-1 Operable Unit with representatives from the EPA and Washington State Department of Ecology.

<u>Task 10: Baseline Risk Assessment</u>; A study will be completed that identifies and assesses the risks associated with potential remedial measures.

Task 11: Phase I Remedial Investigation Report; An interim report will be prepared that summarizes the results of Phase 1 investigations, presents available results from the baseline risk assessment, and provides preliminary characterization of the 300-FF-1 Operable Unit.

### 2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

### 2.1 TECHNICAL LEAD RESPONSIBILITIES

The Environmental Engineering and Technology (EE&T) Function of Westinghouse Hanford Company has primary responsibilities for conducting this investigation. Organizational charts are included in the Project Management Plan (PMP) for this Operable Unit which define personnel assignments and individual Westinghouse Hanford Field Team structures applicable to the various types of tasks included in Phase 1.

External participant contractors or subcontractors shall be evaluated and selected for certain portions of task activities at the direction of the Technical Lead in compliance with standard Westinghouse Hanford procedures for supplier evaluation and procurement. Major participant contractor and subcontractor resources are listed in Figure 2-2 of the Project Management Plan. All contractors plans and procedures shall be approved prior to use, and shall be available for regulatory review after Westinghouse Hanford approval. All analytical procedures shall be reviewed and approved by the Westinghouse Hanford Analytical Laboratories organization.

### 2.2 ANALYTICAL LABORATORIES

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All analyses shall be performed in compliance with Westinghouse Hanford approved laboratory QA plans and analytical procedures, subject to standard Westinghouse Hanford procurement and internal and external quality auditing and surveillance controls. Extensive upgrades of Westinghouse Hanford laboratory analytical capabilities for hazardous substances are planned for FY 89. As additional capabilities in hazardous sample analysis are developed and approved, laboratory procedures will be prepared and updated in compliance with standard Westinghouse Hanford procedural controls. For participant contractors and subcontractors, applicable quality requirements shall be invoked as part of the approved procurement documentation or work order. Services of alternate qualified laboratories may be procured for the performance of split sample analysis at the Technical Lead's option. If such an option is selected, the laboratory QA plan and applicable analytical procedures must be approved prior to their use.

### 2.3 OTHER SUPPORT CONTRACTORS

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Procurements of all other contracted field activities shall be in compliance with referenced procurement procedures as discussed in 2.1 and 2.2 above. All work shall be performed in compliance with Westinghouse Hanford approved QA plans and/or procedures, subject to standard internal and external quality auditing and surveillance controls. Applicable quality requirements shall be invoked as part of the approved procurement documentation or work order.

### 3.0 OBJECTIVES FOR MEASUREMENT DATA

Data quality objectives for the 300-FF-l operable unit are summarized in Table 4-1 of the Work Plan. Additional analytical data based on soil and groundwater sampling activities will be obtained and evaluated in order to further characterize the nature and extent of radioactive and hazardous contamination, and to determine the most feasible options for remediation. The analytes of interest for this operable unit include uranium 235 and 238, ions, metals, volatile organic compounds, and one PCB compound. Analytical data will be obtained at two different levels, based on the criteria provided in Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA, 1987a). They are described as follows:

Level III: Level III analyses will be performed on all analytes. All analyses shall be performed onsite or offsite by appropriately equipped Westinghouse Hanford, participant contractor, or subcontractor laboratories, based on the results of Level I radiation screening as described below. Analytical detection limits, precision, and accuracy shall be specified in the analytical method, which shall be reviewed and approved prior to use in compliance with standard Westinghouse Hanford procurement control and/or procedure control procedures.

<u>Level I</u>: Soil samples shall undergo field screening to determine gross alpha and beta/gamma radiation. Samples exhibiting radioactivity greater than 200 counts per minute will be automatically routed to an appropriately equipped and qualified onsite Westinghouse Hanford or participant contractor laboratory for analysis. Screening shall be performed by qualified Westinghouse Hanford Radiation Protection Technologists as specified in governing procedures.

As noted in Section 4.6 of <u>Data Quality Objectives for Remedial Response Activities: Volume I. Development Process</u> (EPA, 1987a), universal goals for precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) cannot be practically established at the outset of an investigation. Where standard reference methods are provided, however, minimum guidelines are available that may be used in the preparation of analytical methods appropriate for this investigation. Table 3-1 provides general guidelines and reference sources for method detection limits, precision, and accuracy as available for each analyte of interest. Once individual laboratory statements of work are negotiated, and procedures are developed and approved in compliance with standard Westinghouse Hanford

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 300-FF-1 Operable Unit (sheet 1 of 3)

| Category<br>of Analysis    | Analyte of<br>Interest | Analytical<br>Level(1) | Standard or<br>Reference<br>Method | Analytical<br>Method | MDC(2) | Precision<br>(soil) | Accuracy<br>(soil) | MDL(3) | Precision<br>(water) | Accuracy<br>(water) |
|----------------------------|------------------------|------------------------|------------------------------------|----------------------|--------|---------------------|--------------------|--------|----------------------|---------------------|
| Radiation                  | Gross Alpha            | ī                      | N/A                                | (4)                  | N/A    | N/A                 | N/A                | N/A    | N/A                  | N/A                 |
| Screening                  | Gross Beta/Gamma       | I                      | N/A                                | (4)                  | N/A    | N/A                 | N/A                | N/A    | N/A                  | N/A                 |
| Organic Vapor<br>Screening | All volatile organics  | I                      | N/A                                | (4)                  | N/A    | N/A                 | N/A                | N/A    | N/A                  | N/A                 |
| Radionuclide               | Gross Alpha            | 111                    | 9310(5)                            | . (4)                | (6)    | (6)                 | (6)                | (6)    | (6)                  | ,<br>(6)            |
| Ana lysis                  | Gross Beta             | 111                    | 9310(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Uranium 235            | 111                    | 9310(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Uranium 238            | III                    | 9310(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
| Metals                     | Aluminum               | 111                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
| Analysis                   | Ant imony              | 111                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Beryllium              | 111                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Cadmium                | III                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Chromium               | 111                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Copper                 | 111                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Iron                   | III                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Lead                   | 111                    | 7420 or 7421(5)                    | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Manganese              | III                    | 7460 or 7461(5)                    | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Mercury                | 111                    | 7470 or 7471(5)                    | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Nickel                 | Ш                      | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Silver                 | III                    | 6010(5)                            | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |
|                            | Zinc                   | 111                    | 7950 or 7951(5)                    | (4)                  | (6)    | (6)                 | (6)                | (6)    | (6)                  | (6)                 |

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 300-FF-1 Operable Unit (sheet 2 of 3)

| Category<br>of Analysis | Analyte of<br>Interest            | Analytical<br>Level(1) | Standard or<br>Reference<br>Method | Analytical<br>Method | MDC(2)         | Precision<br>(soil) | Accuracy<br>(soil) | MDL(3)           | Precision (water) | Accuracy<br>(water) |
|-------------------------|-----------------------------------|------------------------|------------------------------------|----------------------|----------------|---------------------|--------------------|------------------|-------------------|---------------------|
| Ion                     | Ammonium                          | 111                    | ASTM-D-4327(7)                     | (4)                  | 1 <b>µ</b> g/g | per 4327            | per 4327           | 500 <b>μ</b> g/L | per 4327          | per 4327            |
| Analysis                | Fluoride                          | 111                    | ASTM-D-4327(7)                     | (4)                  | 1 <b>μ</b> g/g |                     | per 4327           | 500 μg/L         |                   | per 4327            |
|                         | Nitrate                           | 111                    | N/A                                | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
|                         | Nitrite                           | III                    | N/A                                | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
| Volatile                | trans-1,2-Dichloroethylene        | 111                    | 8240(5)                            | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
| Organic                 | Methylene chloride                | 111                    | 8240(5)                            | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
|                         | Tetrachloroethylene               | 111                    | 8240(5)                            | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
|                         | Trichloroethylene                 | 111                    | 8240(5)                            | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
| PCB Analysis            | Arochlor 1248                     | III                    | 8080(5)                            | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
| Other<br>Analyses       | Cation Exchange<br>Capacity (CEC) | III                    | 9080 or 9081(5)                    | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
|                         | pH (soil)                         | 111                    | 9045(5)                            | (4)                  | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |
|                         | pH (water)                        | 111                    | N/A                                | (4).                 | (6)            | (6)                 | (6)                | (6)              | (6)               | (6)                 |

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 300-FF-1 Operable Unit (sheet 3 of 3)

### Notes:

- (1) Analytical levels are as defined in Section 4.3.1 of <u>Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process</u> (EPA, 1987a) and Table 4-1 of the Work Plan for this operable unit.
- (2) MDC refers to minimum detectable concentration in soil.
- (3) MDL refers to minimum detection limit in water.
- (4) Analytical methods shall be approved Westinghouse Hanford or Westinghouse Hanford-approved participant contractor or subcontractor procedures. All procedure reviews and approvals shall be in compliance with applicable Westinghouse Hanford procedure control or procurement procedures.
- (5) Standard methods are from <u>Test Method for Evaluating Solid Wastes (SW-846)</u>, Third Edition (EPA, 1986).
- (6) Minimum requirements for method detection levels, precision, and accuracy will be method-specific, and shall be negotiated and established in the procedure review and approval process.
- (7) Standard methods are from 1988 Annual Book of ASTM Standards (ASTM, 1987).

procurement control procedures. Table 3-1 shall be revised to reference approved detection limit, precision, and accuracy criteria as project requirements.

Goals for data representativeness are addressed qualitatively by the specification of sampling locations and intervals within the Field Sampling Plan (FSP) for this operable unit. Objectives for completeness for this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 80 percent of the total number of requested determinations. Failure to meet this criterion shall be documented as a nonconformance, subject to corrective action as required by applicable Westinghouse Hanford procedures. Approved analytical procedures shall require that use of standard reporting techniques and units wherever possible to facilitate the comparability of data sets in terms of precision and accuracy.

### 4.0 SAMPLING AND ANALYSIS PROCEDURES

### 4.1 PROCEDURE APPROVALS AND CONTROL

All procedures required for Phase I activities shall be approved in compliance with applicable Westinghouse Hanford procedures. Where Westinghouse Hanford Environmental Investigation Instructions (EIIs) are referenced, they shall be the latest approved versions. Where Westinghouse Hanford analytical laboratory procedures are referenced, they shall be the latest approved version defined within procedures manuals for the applicable facilities, reviewed and approved in compliance with standard procedures. Participating contractor or subcontractor QA plans and procedures shall be reviewed, approved and maintained as project quality records. All approved procedures are available for regulatory review on request by direction of the Westinghouse Hanford Technical Lead.

### 4.2 SAMPLING PROCEDURES

### 4.2.1 Soil Sampling

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All soil sampling shall be performed in accordance with the EII for soil and sediment sampling. All boreholes shall be logged in compliance with the EII for geologic logging. Sample numbers, types, location, and other site specific considerations shall be as defined by the Field Sampling Plan (FSP) prepared for this operable unit. Documentation requirements are contained within individual EIIs and the Data Management Plan (DMP). All procedures related to soil sampling are identified in Table 4-1 as applicable to individual tasks.

Table 4-1. Sampling and Investigative Procedures for Phase I Investigations in the 300-FF-1 Operable Unit (Sheet 1 of 4)

| PROCEDURE SUBJECT(1)                                                      | TASK 1<br>SOURCE<br>INVESTIGATION | TASK 2<br>GEOLOGICAL<br>INVESTIGATION | TASK 3<br>SOIL<br>INVESTIGATION | TASK 4<br>GROUNDWATER<br>INVESTIGATION | TASK 5 SURFACE WATER AND SEDIMENT INVESTIGATION | TASK 6<br>AIR<br>INVESTIGATION | TASK 7<br>BIOLOGICAL<br>INVESTIGATION |
|---------------------------------------------------------------------------|-----------------------------------|---------------------------------------|---------------------------------|----------------------------------------|-------------------------------------------------|--------------------------------|---------------------------------------|
| Chain of Custody                                                          |                                   |                                       | X                               | x                                      | x                                               |                                |                                       |
| Soil and Sediment Sampling                                                |                                   |                                       | x                               |                                        | X                                               |                                |                                       |
| Field Decontamination of Drilling Equipment                               |                                   |                                       | X                               |                                        | X                                               |                                |                                       |
| econtamination of Equipment<br>or RCRA/CERCLA Sampling                    | X                                 | <b>X</b> .                            | X                               | X                                      | X                                               |                                |                                       |
| anford Geotechnical<br>ibrary Control                                     |                                   |                                       | X                               | x                                      | X                                               |                                |                                       |
| ctivity Reports of Field                                                  | X                                 | X                                     | x                               | X                                      | X                                               | X                              | Х                                     |
| roundwater Monitoring Wells<br>echnical Inspection                        |                                   |                                       |                                 | X                                      |                                                 |                                |                                       |
| reparation of Groundwater<br>onitoring Well Construction<br>pecifications |                                   |                                       |                                 | x                                      |                                                 |                                |                                       |
| roundwater Monitoring Well<br>aintenance                                  |                                   |                                       |                                 | x                                      |                                                 |                                |                                       |

Table 4-1. Sampling and Investigative Procedures for Phase I Investigations in the 300-FF-1 Operable Unit (Sheet 2 of 4)

| · · · · · · · · · · · · · · · · · · ·                  | · · · · · · · · · · · · · · · · · · · |                                       |                                 |                                        | 4                                                        |                                |                                       |
|--------------------------------------------------------|---------------------------------------|---------------------------------------|---------------------------------|----------------------------------------|----------------------------------------------------------|--------------------------------|---------------------------------------|
| PROCEDURE SUBJECT(1)                                   | TASK 1<br>SOURCE<br>INVESTIGATION     | TASK 2<br>GEOLOGICAL<br>INVESTIGATION | TASK 3<br>SOIL<br>INVESTIGATION | TASK 4<br>GROUNDWATER<br>INVESTIGATION | TASK 5<br>SURFACE WATER<br>AND SEDIMENT<br>INVESTIGATION | TASK 6<br>AIR<br>INVESTIGATION | TASK 7<br>BIOLOGICAL<br>INVESTIGATION |
| Nonradioactive Hazardous<br>Waste Disposal             | X                                     |                                       | X                               | , X                                    | х                                                        |                                |                                       |
| User Calibration of<br>Health & Safety M&TE            | X                                     | X                                     | X                               | X                                      | X                                                        |                                |                                       |
| Borehole/Site Reclamation and Verification             | X                                     |                                       | X                               |                                        |                                                          |                                |                                       |
| Borehole/Site Reclamation<br>Activity Reports          | X                                     |                                       | <b>X</b>                        |                                        |                                                          |                                |                                       |
| Geologic Logging                                       | x                                     |                                       | X                               |                                        |                                                          |                                |                                       |
| Aquifer Testing                                        |                                       |                                       |                                 | , <b>X</b>                             |                                                          |                                |                                       |
| Measurement of Groundwater<br>Levels                   |                                       |                                       |                                 | X                                      |                                                          |                                |                                       |
| Disposal of Well<br>Construction/Development<br>Waters |                                       |                                       |                                 | <b>x</b>                               |                                                          |                                |                                       |
| Water Sampling (PNL Procedure;<br>see Note 2)          |                                       |                                       |                                 | X                                      |                                                          |                                |                                       |

Table 4-1. Sampling and Investigative Procedures for Phase I Investigations in the 300-FF-1 Operable Unit (Sheet 3 of 4)

| PROCEDURE SUBJECT(1)                                     | TASK 1<br>SOURCE<br>INVESTIGATION | TASK 2<br>GEOLOGICAL<br>INVESTIGATION | TASK 3<br>SOIL<br>INVESTIGATION | TASK 4<br>GROUNDWATER<br>INVESTIGATION | TASK 5 SURFACE WATER AND SEDIMENT INVESTIGATION | TASK 6<br>AIR<br>INVESTIGATION | TASK 7<br>BIOLOGICAL<br>INVESTIGATION |
|----------------------------------------------------------|-----------------------------------|---------------------------------------|---------------------------------|----------------------------------------|-------------------------------------------------|--------------------------------|---------------------------------------|
| Air Honitoring (2) .                                     |                                   |                                       |                                 |                                        |                                                 | x                              |                                       |
| Geodetic Surveying (Kaiser<br>Procedures; see Note 2)    | X                                 |                                       | X                               | <b>X</b>                               | X                                               |                                |                                       |
| Electromagnetic Surveying (2)                            | x                                 | X                                     |                                 |                                        |                                                 |                                |                                       |
| Scintillation Surveying (2)                              |                                   |                                       | X                               |                                        | •                                               |                                |                                       |
| Tracer Gas Surveying and<br>Underground Leak Testing (3) | x                                 |                                       |                                 |                                        |                                                 |                                |                                       |
| Gaging Station Construction                              |                                   |                                       |                                 |                                        | X                                               |                                |                                       |
| Ground-Penetrating Radar                                 | Х                                 |                                       |                                 |                                        |                                                 |                                |                                       |

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Table 4-1. Sampling and Investigative Procedures for Phase I Investigations in the 300-FF-1 Operable Unit (Sheet 4 of 4)

### Notes:

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- (1) Procedures are Westinghouse Hanford Environmental Investigations Instructions (EIIs) unless participant contractor or subcontractor procedures are indicated. All procedures listed are directly applicable to the performance of field task activities. Other EIIs applicable to the documentation or administration of all tasks include the following subjects:
  - o preparation of EIIs
  - o desk instruction preparation
  - o deviations from EIIs
  - o dosimetry
  - o lock and tag requirements
  - o pest control

- o indoctrination, training, and qualification
- o controlled notebooks
- o records management
- o field logbooks
- o preparation of Health & Safety plans
- (2) All participant contractor and subcontractor procedures shall be reviewed and approved by Westinghouse Hanford prior to use; approved procedures are retained in project quality records and are available for regulatory review upon request at the direction of the Westinghouse Hanford Technical Lead. Laboratory analytical procedures are further defined in Section 3.0, Table 3-1, and Section 7.0.
- (3) Procedures will be developed by Westinghouse Hanford participating organizations, participant contractors, or subcontractors in compliance with the procurement control, procedure control, and test control requirements promulgated by Westinghouse Hanford. All procedures will be reviewed and approved by Westinghouse Hanford prior to use, and shall be available upon request at the direction of the Westinghouse Hanford Technical Lead.
- (4) Analytical Level I radiation screening procedures shall be as specified by standard Westinghouse Hanford radiological protection operating procedures.

All groundwater sampling shall be performed by PNL under the supervision of the Westinghouse Hanford Field Team Leader in compliance with Westinghouse Hanford-approved procedures. The EII for chain of custody shall be invoked as procurement QA requirements in accordance with governing procurement control procedures. Documentation requirements shall be defined within approved PNL procedures and the DMP. All procedures related to groundwater sampling are identified in Table 4-1 as applicable to individual tasks.

### 4.2.3 Sample Container Selection

Sample container types and preservation requirements for Phase 1 of this investigation shall be specified by the FSP; sample container types, container preparation codes, preparation requirements, and special handling requirements are defined the EII for soil and sediment sampling. Similar requirements for groundwater sampling shall be contained within approved PNL procedures.

### 4.3 OTHER PROCEDURES

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Other procedures that will be required specifically for this phase of the investigation are identified in Table 4-1 for each individual task. Documentation requirements shall be addressed within individual procedures and/or the DMP as appropriate. Analytical procedures are discussed in detail in Section 7.0 and are listed in Table 3-1.

### 4.4 PROCEDURE CHANGES

Should deviations from established EIIs be required to accommodate unforseen field situations, they may be authorized by the Field Team Leader in accordance with the requirements of the EII prepared to control deviation from EII requirements. Documentation, review, and disposition of instruction change authorization forms are defined within the EII. Other types of procedure change requests shall be documented as required by the Westinghouse Hanford procedures governing their preparation.

### 5.0 SAMPLE CUSTODY

### 5.1 CHAIN OF CUSTODY PROCEDURES

All samples obtained during the course of this investigation shall be controlled as required by the EII for chain of custody from the point of origin to the analytical laboratory. Laboratory chain of custody procedures shall be reviewed and approved as required by Westinghouse Hanford procurement control procedures, and shall ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the Technical Lead, requirements for return of residual sample materials after completion of analysis shall be defined in accordance procedures defined in the procurement documentation to subcontractor or participant contractor laboratories. Chain of custody forms shall be initiated for returned residual

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samples as required by the approved procedures applicable within the participating laboratory. Results of analyses shall be traceable to original samples through the unique code or identifier specified by the FSP. Results shall be controlled as permanent project quality records as required by standard Westinghouse Hanford procedures and the Data Management Plan (DMP).

### 6.0 CALIBRATION PROCEDURES

Calibration of all Westinghouse Hanford measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled as required by calibration programs in compliance with standard Westinghouse Hanford procedures.

All calibration of Westinghouse Hanford or contractor laboratory measuring and test equipment shall meet the minimum requirements of <u>Test Methods for Evaluating Solid Waste (SW-846)</u> (EPA, 1986) as modified by the proposed rules contained in the <u>Federal Register</u>, Volume 54, No. 13 (EPA, 1989). Such requirements shall be invoked wherever required through standard Westinghouse Hanford procurement control procedures.

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### 7.0 ANALYTICAL PROCEDURES

Analytical methods or procedures for each analytical level identified in Section 3.0 above shall be selected or developed and approved prior to use in compliance with appropriate Westinghouse Hanford procedure and/or procurement control requirements. As noted in Section 4.6 of <u>Data Quality Objectives for</u> Remedial Response Activities: Volume 1, Development Process (EPA, 1987a), universal goals for precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) cannot be practically specified at the outset of an investigation. Where standard reference methods are available, however, minimum guidelines are provided that may be used in the preparation of analytical methods appropriate for this investigation. Table 3-1 provides general guidelines and reference sources for method detection limits, precision, and accuracy, as available for each analyte of interest and sorted by the required analytical level. Where guidelines are not available, statistical guidelines appropriate for determining precision and accuracy shall be developed, included in procedures, and submitted for Westinghouse Hanford review and approval. The guidance provided in Appendix C, "Recommended Statistical Methods for Assessing Precision, Accuracy, and Completeness" may be used in such situations as appropriate for the development of procedural guidelines. Once individual laboratory statements of work are negotiated, and procedures are approved in compliance with appropriate Westinghouse Hanford requirements, Table 3-1 shall be revised to include actual method references, approved detection limit, precision, and accuracy criteria as project requirements.

All analytical procedures approved for use in this investigation shall require the use of standard reporting techniques and units wherever possible to facilitate the comparability of data sets in terms of precision and accuracy. All approved procedures shall be retained in the project QA

records, and shall be available for regulatory review upon request by the direction the Westinghouse Hanford Technical Lead.

### 8.0 DATA REDUCTION, VALIDATION AND REPORTING

Analytical data from sampling activities will be used primarily to determine the presence and amounts of analytes of interest in the sampled locations or intervals. Analytical laboratories shall be responsible for the examination and validation of analytical results to the extent appropriate for the analytical level. The requirements discussed in this section shall be invoked, as appropriate, in procurement documentation prepared in compliance with standard Westinghouse Hanford procedures. Results from all Level III analyses shall be summarized in a validation report and supported by recovery percentages, quality control checks, equipment calibration data, chromatograms, spectrograms, and other validation data. Specific validation criteria for Level III methods shall be as defined in the individual method. All validation reports and supporting data shall be subjected to a detailed technical review by a qualified reviewer designated by the Westinghouse Hanford Technical Lead. All validation reports, technical reviews, and supporting data shall be retained as permanent project quality records in compliance with referenced procedures and the DMP.

### 9.0 INTERNAL QUALITY CONTROL

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The quality of analytical samples shall be subject to in-process quality control measures in both the field and laboratory. Unless otherwise specified in the approved Field Sampling Plan (FSP), minimum field quality control activities shall include:

- Field Duplicate Samples: For each shift of sampling activity under an individual sampling subtask, a minimum of 5 percent of the total collected samples shall be duplicated, or one duplicate shall be collected for every 20 samples, whichever is greater. Duplicate samples shall be retrieved using the same equipment and sampling technique, and shall be placed into two identically prepared and preserved containers. All field duplicates shall be analyzed independently as an indication of gross errors in sampling techniques.
- Field Blanks: Field blanks shall consist of pure deionized distilled water, transferred into a sample container at the site and preserved with the reagent specified for the analytes of interest. Field blanks are used as a check on reagent and environmental contamination, and shall be collected at the same frequency as field duplicate samples.
- Split Samples (optional): At the Technical Lead's option, up to 50 percent of the total number of duplicate samples may be split in the field and sent to an alternate laboratory as a check on the methods, precision, and accuracy of the primary laboratory.

- Equipment Blanks: Equipment blanks shall consist of pure deionized distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks are used to verify the adequacy of sampling equipment decontamination procedures, and shall be collected at the same frequency as field duplicate samples.
- Trip Blanks: Trip blanks consist of pure deionized distilled water added to one clean sample container, accompanying each batch of containers shipped to the sampling activity. Trip blanks shall be returned unopened to the laboratory, and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions. In compliance with standards Westinghouse Hanford procurement procedures, requirements documents of work orders to the sample container supplier and/or preparer.

In response to the specific data quality needs of this investigation, the internal quality control checks performed by analytical laboratories for Level III analyses shall meet the minimum requirements of <u>Test Methods for Evaluating Solid Waste (SW-846)</u> (EPA, 1986) as modified by the proposed rules contained in the <u>Federal Register</u>, Volume 54, No. 13 (EPA, 1989). The minimum requirements of this Section shall be invoked in procurement documents or work orders in compliance with standard Mestinghouse Hanford procedures.

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### 10.0 PERFORMANCE AND SYSTEM AUDITS

Acceptable performance for this project is defined as compliance with the requirements of this QAPP, its implementing procedures and appendices, and associated plans such as the Field Sampling Plan, Data Management Plan, and other applicable Westinghouse Hanford quality assurance program plans. All activities addressed by this QAPP are subject to planned audits of project performance and systems adequacy at the onset of project activity, and near completion of each phase. Audits may be scheduled more often at the request of the Quality Coordinator or Technical Lead. Audits shall be conducted in accordance with appropriate Westinghouse Hanford procedures. Audit planning shall consider specific Westinghouse Hanford quality assurance program plan requirements, this QAPP, and all applicable Westinghouse Hanford subcontractor, or participating contractor procedures.

After completion of an initial system and performance audits, all activities addressed by this QAPP may be subjected to periodic surveillance in accordance with appropriate Westinghouse Hanford procedures. Surveillances shall be scheduled at the request of the Project QA Manager or Project Manager. Discrepancies observed during surveillance that cannot be immediately corrected within procedure allowances shall be documented as nonconformances and dispositioned as required by applicable nonconformance control procedures. When unpredicted field situations require a deviation in EII provisions, they shall be authorized in compliance with the appropriate deviation request EII. Failure to repeat the technical activity when instruction change authorization forms have been disapproved shall be

automatically considered a nonconformance, subject to the reporting and corrective action controls described above.

### 11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratory that directly affects the quality of the analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime. For this investigation, such measures are confined to laboratory equipment and tracer gas survey equipment, since most field measurements are related either to the measurement of the sample interval or to the determination of radiological or other health and safety hazards. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment; maintenance requirements, spare parts lists, and instructions shall be included in individual methods or laboratory QA plans, subject to Westinghouse Hanford approval.

### 12.0 DATA ASSESSMENT PROCEDURES

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As discussed in Section 8.0 above, a data validation report shall be prepared by the analytical laboratory that summarizes the precision, accuracy, and completeness of the analysis; the report shall compare actual analytical results with the objectives stated in Section 3.0 above. If the stated objectives for a particular parameter are not met, the situation shall be analyzed, and limitations or restrictions on the uses of such data shall be established. The summary report shall be reviewed and approved by the Technical Lead, who may direct additional sampling activities if the objectives for data precision, accuracy, and completeness have not been met. The approved report shall be routed to permanent project quality records and shall also be included within the report that will be prepared for submittal to the regulatory agency at the end of Phase I activities.

### 13.0 CORRECTIVE ACTION

Corrective action requests required as a result of surveillance reports, nonconformance reports, or audit activity shall be documented and dispositioned as required by standard Westinghouse Hanford corrective action procedures. Primary responsibilities for corrective action resolution are assigned to the Technical Lead and the QA Coordinator. Other measurement system, procedures, or plan corrections that may be required as a result of routine review processes shall be resolved as required by governing procedures or shall be referred to the Technical Lead for resolution.

Copies of all surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project records upon completion or closure.

### 14.0 QUALITY ASSURANCE REPORTS

As previously stated in Sections 10.0 and 13.0, project performance shall be regularly assessed by auditing and surveillance processes. Surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project records upon completion or closure of the activity. A report summarizing all audit, surveillance, and instruction change authorization activity, as well as any associated corrective actions, shall be prepared by the Quality Coordinator at the completion of Phase 1 or once annually, whichever is sooner. The report(s) shall be submitted to the Technical Lead for incorporation into the final report prepared at the end of each phase of the investigation. The final report shall include an assessment of the overall adequacy of the total measurement system with regard to the data quality objectives of the investigation.

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### APPENDIX A:

### GLOSSARY

Accuracy: For the purposes of environmental investigations, accuracy may be interpreted as the measure of the bias in a system. Accuracy is the degree of agreement of a measurement (or the average of a set of measurements with identical parameters) with an accepted reference or true value. Accuracy may be expressed as: 1) the difference between the measurement (X) with the reference value (T), i.e., X-T; or 2) the difference between the two values as a percentage of the reference value, i.e., 100(X-T)/T; or simply as the ratio X/T.

Comparability: For the purposes of environmental investigations, comparability is an expression of the relative confidence with which one data set may be compared with another.

Completeness: For the purposes of environmental investigations, completeness may be interpreted as a measure of the amount of data actually obtained from a measurement system against the amount that would be expected under correct normal conditions.

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Deviation: For the purpose of environmental investigations, deviation refers to a planned departure from established criteria that may be required as a result of unforeseen field situations or that may be required to correct ambiguities in procedures that may arise in practical applications.

Nonconformance: A nonconformance is a deficiency in characteristic, documentation or procedure which renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When the deficiency is of a minor nature, does not effect a permanent or significant change in quality if it is not corrected, and can be brought into conformance with immediate corrective action, it shall not be categorized as a nonconformance. However, if the nature of the condition is such that it cannot be immediately and satisfactorily corrected, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision: For the purposes of environmental investigations, precision may be interpreted as a measure of relative agreement between individual measurements made with a common set of parameters or conditions. Precision is normally expressed in terms of the standard deviation.

Quality Assurance: For the purposes of environmental investigations, Quality Assurance (QA) refers to the total integrated quality planning, quality control, quality assessment, and corrective action activities that collectively ensure that the data from monitoring and analysis meets all end user requirements.

Quality Assurance Project Plan: The Quality Assurance Project Plan (QAPP) is an orderly assembly of management policies, project objectives, methods, and procedures that defines how data of known quality will be produced for investigations of individual operable units.

Quality Control: For the purposes of environmental investigations, Quality Control (QC) refers to the routine application of procedures and defined methods to the performance of sampling, measurement, and analytical processes.

Representativeness: For the purposes of environment investigations, representativeness may be interpreted as the degree to which data accurately and precisely expresses the actual characteristics of the environmental conditions at the sampled interval.

Validation: For the purposes of this investigation, representativeness may be interpreted as the degree to which data accurately and precisely expresses that actual characteristics of the environmental conditions at the sampled interval.

Verification: For the purposes of environmental investigations, verification refers to the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities may include inspections, audits, surveillances, or technical review.

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### APPENDIX B

### REFERENCES

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- U.S. Environmental Protection Agency, 1979, <u>Handbook for Analytical Quality Control in Water and Wastewater Laboratories</u>; EPA/Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.
- U.S. Environmental Protection Agency, 1986, <u>Test Methods for Evaluating Solid Waste (SW-846)</u>, Third Edition; EPA/Office of Solid Waste and Emergency Response, Washington, D.C.

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- U.S. Environmental Protection Agency, 1987b, <u>Quality Assurance Handbook for Air Pollution Measurement Systems</u>, <u>Volume 1: Principles</u>; EPA/Office of Research and Development, Environmental Monitoring and Support Laboratory, Research Triangle Park, North Carolina.
- U.S. Environmental Protection Agency, 1988, <u>Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA</u> (OSWER directive 9335.3-01, Draft); EPA/Office of Solid Waste and Emergency Response, Washington, D.C.
- U.S. Environmental Protection Agency, 1989, "Hazardous Waste Management System; Testing and Monitoring Activities (Proposed Rule);" in <u>Federal</u> Register, Vol. 54, No. 13, pp. 3312-3228.

### APPENDIX C

# RECOMMENDED STATISTICAL METHODS FOR ASSESSING PRECISION, ACCURACY, AND COMPLETENESS

### 1.0 SCOPE

This attachment discusses various statistical methods and standard formulae suitable for inclusion in Westinghouse Hanford, participant contractor, or subcontractor laboratory analytical procedures for environmental investigations. Such methods are routinely used to assess the precision, accuracy, and completeness of measurement data within individual analytical procedures. The information provided by this attachment is intended for guidance only; all methods selected or proposed by an individual analytical laboratory for the assessment of data precision, accuracy, and completeness are subject to review and approval prior to use.

### 2.0 STATISTICAL METHODS AND FORMULAE

### 2.1 CENTRAL TENDENCY AND DISPERSION

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Methods for determining central tendencies and dispersion of data may include determination of various statistical values. The arithmetic mean is the average of the sum of a set of n values divided by n;

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$
 (EPA, 1979)

Range simply refers to the difference between the highest and lowest values reported for a sample (EPA, 1979). The standard deviation is the square root of the variance of the population;

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N} X_{i}^{2} - \left(\sum_{i=1}^{N} X_{i}\right)^{2} / N}{N}}$$
 (EPA, 1979)

The standard deviation estimate is the most widely used measure to describe the dispersion of a set of data, and is expressed as follows;

$$S = \sqrt{\frac{\sum_{i=1}^{n} X_{i}^{2} - \left(\sum_{i=1}^{n} X_{i}\right)^{2}/n}{n-1}}$$
 (EPA, 1979)

The relative standard deviation is the ratio of the standard deviation S of a set of numbers to their mean  $\bar{X}$ , expressed as a percentage; it relates the standard deviation (or precision) of a set of data to the size of the numbers;

$$CV = RD \text{ (percent)} = 100 \frac{S}{\overline{X}}$$
 (EPA, 1979)

Skewness is a measure of the asymmetry of a frequency distribution;

$$K = \frac{(X_i - \bar{X})^3}{na^3}$$
 (EPA, 1979)

The geometric mean is a measure of central tendency for data from a positively skewed distribution (log normal);

$$\overline{X}_{g} = \sqrt[n]{(X_{1})(X_{2})...(X_{n})}$$

$$\sum_{i=1}^{n} \log X_{i}$$

$$\overline{X}_{g} = \operatorname{antilog} \frac{\sum_{i=1}^{n} \log X_{i}}{n}$$
(EPA, 1979)

### 2.2 ASSESSMENT OF DATA QUALITY

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Accuracy may be interpreted as the measure of the bias in a measurement system; bias is a systematic error due to the experimental method that causes measured values to deviate from true values. Accuracy is the degree of agreement of a measurement (or the average of a set of measurements with identical parameters) with an accepted reference or true value. Accuracy may be expressed as: 1) the difference between the measurement (X) with the reference value (T), i.e., X-T; or 2) the difference between the two values as a percentage of the reference value, i.e., 100(X-Y)/Y; or simply as the ratio X/T. For the purposes of environmental investigations, precision may be interpreted as a measure of relative agreement or reproducibility between individual measurements made with a common set of parameters or conditions. Precision is normally expressed in terms of the standard deviation, but may also be expressed as the relative standard deviation (coefficent of variation) or range (maximum value minus minimum value; see the discussion in item 2.1

above). Relative error refers to the mean error of a series of measured data values as a percentage of the true value  $X_{t}$ ;

RE (percent) = 
$$100 \frac{|X - \overline{X}|}{X_t}$$
 (EPA, 1979)

For the purposes of environmental investigations, comparability is an expression of the relative confidence with which one data set may be compared with another; see item 2.4 below for a discussion of confidence limits. Completeness may be interpreted as a measure of the amount of data actually obtained from a measurement system against the amount that would be expected under correct normal conditions, and is expressed as follows:

For the purposes of environmental investigations on the Hanford Site, completeness is defined as an objective of meeting established requirements for precision and accuracy for at least 80 percent of the requested determinations.

### 2.3 SIGNIFICANCE TESTS

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Significance testing refers to the various statistical means of checking distribution hypotheses. Such tests include the Student-t test, the chisquared test, the paired t-test, and the F-test, and should be selected to suit the type of hypotheses. Detailed discussions of these types of tests may be found in standard statistics texts such as <u>Probability and Statistics in Modern Engineering</u> (Lapin, 1983) or <u>Probability and Statistics for Engineers</u> (Miller and Freund, 1965).

### 2.4 CONFIDENCE LIMITS

Confidence limits refer to the boundaries of a value interval with a designated probability (the confidence coefficient) of including some defined parameter of the sample population. The confidence coefficient is the probability that the value interval has of including the sample population values. The confidence coefficient is normally expressed as a percentage; for a given sample size, the distance between the confidence limits increases as the coefficient increases. The guidelines, tables, formulae, and figures of Appendix E, "Estimation Procedures", from Quality Assurance Handbook for Air Pollution Measurement Systems (EPA, 1987b) are recommended references for the establishment of confidence limits.

### 2.5 TESTING FOR OUTLIERS

Statistical tests are recommended for the screening of data sets for unusually large or small data values for elimination prior to the analysis or processing of data. The guidelines, tables, formulae, and figures of Appendix F, "Outliers", from Quality Assurance Handbook for Air Pollution Measurement Systems (EPA, 1987b) are recommended for selection of appropriate methods.

### 3.0 MATHEMATICAL TERMS

Mathematical terms used in the formulae discussed above are as follows (EPA, 1979:

K = skewness

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N = population size (if finite) or lot size

n = number of items in the sample or test

S = standard deviation estimate

TX = arithemtic mean

 $\bar{X}_{q}$  = geometric mean of sample measurements

 $X_i$  = ith measurement, or the ith smallest measurement of a set of measurements arranged in ascending order

r = population standard deviation

# ATTACHMENT 2 HEALTH AND SAFETY PLAN

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### 1.2 DESIGNATED SAFETY PERSONNEL

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The following personnel are responsible for site safety and health. This safety plan will not be considered complete until these positions are delegated by project management.

| Field Team Leader                         |  |
|-------------------------------------------|--|
| Site Safety Officer                       |  |
| Radiation Protection Technologists (RPTs) |  |
|                                           |  |

All activities on site must be cleared through the field team leader. The field team leader has responsibility for the following:

- Allocating and administering the resources to successfully comply with all technical and health and safety requirements;
- Verifying that all permits, supporting documentation and clearances are in place, i.e., electrical outage requests, welding permits, excavation permit, HASP, sampling plan, Radiation Work Permit (RWP), onsite/offsite RSR's (radiation shipping records), etc.;
- Providing technical advice during routing operations and emergencies;
- Informing the appropriate Site Management and Safety personnel of the activities to be performed each day;
- Resolving any conflicts that may arise between Radiation Work Permits and implementation of the Health and Safety Plan;
- Handling of emergency response situations as may be required;
- Conducting pre-job safety meeting and periodic tail-gate safety meetings.
- Interactions with adjacent building occupants and/or inquisitive public.

The site safety officer shall act as the site safety and health supervisor and is responsible for implementing the HASP at the site. The Site Safety Officer shall:

- Prepare each site safety plan (SSP);
- Monitor chemical, physical, and (in conjunction with the RPT)
  radiation hazards to assess the degree of hazard present.
  Monitoring shall specifically include organic vapor detection,
  radiation screening, and confined space evaluation;

- Determine protection levels, clothing and equipment needed to ensure the safety of personnel in conjunction with the RPT;
- Monitor performance of all personnel to ensure that the required safety procedures are followed;
- Halt operations immediately, if necessary;
- Conduct safety briefings as necessary; and
- At the field team leader's request, prepare summary reports of health and safety activities at the conclusion of each task.

The Radiation Protection Technologist is responsible for assuring that all radiological monitoring and protection procedures are being followed as specified in the PNL Radiation Work Permit. Industrial Hygiene and Safety personnel will provide Safety an overview during drilling operations consistent with WHC Policy and provide technical advice as requested. Also, an additional Industrial Hygienist may be requested to provide downwind sampling and other analyses beyond the scope of PNL capabilities.

The ultimate responsibility and ultimate authority for employee health and safety lies with the employee himself, and his or her colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above. In the event of an immediately dangerous or life threatening situation, the employee automatically has "stop-work" authority and the responsibility to immediately notify the Field Team Leader or Site Safety Officer.

### 1.3 MEDICAL SURVEILLANCE

All WHC personnel and contractors engaged in on site activities on the 300-FF-1 Operable Unit must have baseline physical examinations and be participants in WHC's (or an equivalent) medical surveillance program.

Medical examinations will be designed by the Hanford Environmental Health Foundation (HEHF) to identify any pre-existing conditions which may place an employee at high risk, and will verify that each worker is physically able to perform the work required by this work plan without undue risk to his/her health. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of self-contained breathing apparatus. The physician shall also determine the presence of conditions that may pose undue risk to the employee while performing the physical tasks of this work plan using level B personal protection equipment. This would include any condition that increases the employee's susceptibility to heat stress.

The examining physician's report will not include any non-occupational diagnoses unless directly related to the employee's fitness for the work required.

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### 1.4 TRAINING

Prior to engaging in any on site remedial investigation activities, each team member is required to have received 40 hours of health and safety training related to hazardous waste site operations and at least 8 hours of refresher training each year thereafter as specified in 29 CFR 1910.120. At a minimum this training must include the following topics:

- Employee rights and responsibilities under OSHA.
- Personal protection equipment (PPE) and clothing, use and care, particularly fitting, operation and use of cascade breathing air systems and self-contained breathing apparatus (SCBA).
- Chemical and radiological hazard recognition.
- Radiation worker training.
- Emergency response, self-rescue and first aid.
- Vehicle operation; mandatory rules and regulations.
- Safe use of drilling and sampling equipment.
- Handling, storage and transportation of hazardous chemical and radioactive materials.
- Site control and management.
- Safe sampling techniques.
- Site surveillance, observation and safety plan development.
- Proper decontamination methods for personnel, protective clothing and equipment.
- Use of field test equipment for radioactivity, explosivity and other measurements as needed.
- Communication procedures.

The Field Team Leader and Site Safety Officer will provide site specific instructions regarding anticipated hazards, levels of protection, site monitoring, and operation of equipment as appropriate.

In addition, each inexperienced employee will be accompanied by an employee experienced in characterization activities for a minimum of 3 days of field procedures.

The Field Team Leader and the Site Safety Officer will receive an additional 8 hours of training (in addition to refresher training discussed above) to cover the following topics:

- Management of restricted and safe zones.
- Rules for handling untrained site visitors.
- Site management.

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• Other environmental, safety and health topics which relate to the sampling and characterization effort.

### 1.5 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees who may be required to use air purifying or air supplied respirators must be included in the medical surveillance program and be approved for the use of respiratory protection by a licensed physician. Each team member must be trained in the selection, limitations, and proper use and maintenance of respiratory protection. Existing respiratory protection training may be applicable towards the 40 hour training requirement.

Finally, prior to using any air purifying respirator, each employee must be fit tested (or have been fit tested within the past year) for the specific make, model, and size of respirator he or she will be using according to WHC and/or PNL qualitative and/or quantitative fit testing procedures. Beards (including a few days growth), large sideburns or moustaches which may interfere with a proper respirator seal are not permitted.

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### 2.0 GENERAL PROCEDURES

The following personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. These guidelines represent the minimum standard procedures for reducing potential risks associated with this project and are to be followed by WHC employees at all times.

### 2.1 GENERAL WORK SAFETY PRACTICES

### 2.1.1 Work Practices

- Eating, drinking, smoking, taking medications, chewing gum, etc., is prohibited within the Exclusion Zone. All sanitation facilities shall be located outside of the Exclusion Zone; decontamination is required prior to using such facilities.
- Personnel shall avoid direct contact with contaminated materials unless necessary for sample collection or required observation. Remote handling of casing, auger flights, etc. will be practiced whenever practical.
- Do not handle soil, waste samples, or any other potentially contaminated items unless wearing NBR (nitrile- butyl rubber) or Neoprene rubber gloves.
- Stand upwind of excavations, boreholes, well casings, drilling spoils, etc., as indicated by an onsite windsock whenever possible.
- Stand well clear of the trench during excavation. Always approach the excavation from upwind.
- Be alert to potentially changing exposure conditions as evidenced by perceptible odors, unusual appearance of excavated soils, oily sheen on water, etc.
- Do not enter any test pit trench greater than four feet in depth unless in accordance with procedures specified below.
- Do not, <u>under any circumstances</u>, enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying human passengers.
- All drilling operations members must make a conscientious effort to remain aware of their own and other's positions in regards to rotating equipment, cat heads, u-joints, etc. and be extremely careful when assembling, lifting and carrying flights or pipe to avoid pinch point injuries and collisions.
- Tools and equipment will be kept off the ground whenever possible to avoid tripping hazards and the spread of contamination.

- While operating in the controlled zone personnel shall use the "buddy system" or be in visual contact with someone outside of the controlled zone at all times.
- The buddy system will be used where appropriate for manual lifting.
- Personnel not involved in operation of the cable tool drill rig or monitoring activities shall remain a safe distance from the rig as indicated by the Field Team Leader.
- Follow all provisions of each site specific cutting and welding permit.
- Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry prairie grass. Team members should not drive over dry grass that is higher than the ground clearance of the vehicle and should be aware of the potential fire hazard posed by catalytic converters at all times. Never allow a running vehicle to sit in a stationary location over dry grass or other combustible materials.
- Requirements of General Regulations and Practices for Radiation Work (GEN-0) shall be followed for all work involving radiative materials or radioactive contamination.
- Team members will attempt to minimize truck tire disturbance of all stabilized sites.
- Work operations on site shall not start before sunrise and shall cease at sunset, unless the entire control zone is adequately illuminated with artificial lighting. A new tour (shift) will man the drilling rig after completion of each shift.
- All team personnel are required to attend a pre-job safety meeting prior to the start of the campaign.
- A mandatory "tail-gate" meeting will be conducted prior to each hole drilling operation.

### 2.1.2 Personal Protective Equipment

- Hard hats, safety glasses and steel toe boots will be worn when inside the exclusion zone.
- Personnel shall maintain a high level of awareness of the limitations in mobility, dexterity and visual impairment inherent in the use of Level B and Level C personal protection equipment.
- Be alert to the symptoms of fatigue and heat stress, and their effect on the normal caution and judgment of personnel.

- Always use an appropriate level of personal protection. Lesser levels of protection can result in otherwise preventable exposure; excessive levels of safety equipment can impair efficiency and increase the potential for accidents to occur.
- Noise may pose a health and safety hazard, particularly during drilling and construction activities. A good rule of thumb is that if you have to raise your voice in order to communicate at a distance of three feet in steady state (continuous) noise, you should be wearing hearing protection (disposable ear plugs). Likewise, any impact noise from activities such as driving casing on a drilling operation which is loud enough to cause wincing or discomfort, would also indicate the use of hearing protection. Hearing protection is available and should be included in your standard field kit along with hard hat, safety glasses, etc.
- Life jackets must be worn and employees shall use the "buddy system" for any activities over water, for example, water column sampling of the Columbia River. Additional rescue equipment such as a rope or pole shall also be available.

### 2.1.3 Decontamination

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- Thoroughly wash hands and face before eating or putting anything in your mouth, i.e., avoid hand to mouth contamination.
- At the end of each work day, or each job, disposable clothing shall be removed and placed in drums (chemical contamination) or plastic lined rad boxes as appropriate. Clothing that can be cleaned shall be sent to the Hanford laundry.
- Individuals are expected to thoroughly shower at home, or as soon as possible after leaving the job site if directed to do so by the RPT, Site Safety Officer or Field Team Leader.

### 2.1.4 Emergency Preparation

- A multi-purpose dry chemical fire extinguisher, a fire shovel, a complete field first-aid kit (including bottles of eyewash solution), and a portable deluge shower shall be available at every drill site.
- Establish prearranged hand signals or other means of emergency communication when wearing respiratory equipment, since this equipment seriously impairs speech communications.

### 2.2 CONFINED SPACE/TEST PIT ENTRY PROCEDURES

The following procedures apply to the entry of any confined space which for the purpose of this document shall be defined as any space having limited egress (access to an exist) and the potential for the presence or accumulation of a toxic or explosive atmosphere. This includes manholes, certain trenches

particularly those through waste disposal areas, and all test pits greater than 4 feet in depth in potentially contaminated soil.

The identified remedial investigation activities on the 300-FF-1 Operable Unit should not require confined space entry. Nevertheless, the hazards associated with confined spaces are of such severity that all employees should be familiar with the safe work practices discussed below.

No employee shall enter any test pit or trench greater than 4 feet in depth unless the sides are shored or laid back to a stable slope as specified in 29 CFR 1926.652 or equivalent State Occupational Health and Safety Regulations.

When an employee is required to enter a pit or trench 4 or more feet in depth, an adequate means of access and egress such as a slope of at least 2:1 to the bottom of the pit, or a secure ladder or steps shall be provided.

Prior to entering any confined space including <u>any test pit</u> or any trench which may have the potential for the accumulation of toxic gases or vapors, the atmosphere at the bottom of the space and at four foot intervals thereafter (if greater than four feet in depth) shall be tested for radioactivity, oxygen deficiency, hydrogen sulfide (H<sub>2</sub>S), combustible gases, and organic vapors in that order. If the excavation is located in an area containing known or suspected to cyanide wastes, the atmosphere shall also be tested for hydrogen cyanide. Depending on the situation, the space may require ventilation and retesting prior to entry.

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Any employee entering a confined or partially confined space must be equipped with an appropriate level of respiratory protection in keeping with the monitoring procedures discussed above, and the action levels for airborne contaminants established in Section 5.0 below (see Warnings and Action Levels in SSP).

No employee shall enter any test pit requiring the use of Level B (see Section 6.1) protection, unless a back-up person also equipped with a pressure demand self-contained breathing apparatus is present. No back-up person shall attempt any emergency rescue unless a second back-up person equipped with an SCBA is present, or the appropriate emergency response authorities have been notified and additional help is on the way.

#### 3.0 SITE BACKGROUND

#### 3.1 DESCRIPTION OF FACILITIES IN OPERABLE UNIT 300-FF-1

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The 300-FF-1 Operable Unit is located within the northeast section of the 300 Area, immediately adjacent to the Columbia River at the southeast corner of the Hanford Site. Table 3-1 contains a list of the facilities within the 300-FF-1 Operable Unit, and their periods of operation. All of the major past and present liquid waste disposal facilities in the 300 Area are included in the 300-FF-1 Operable Unit. Three of these facilities - the south process pond, the north process pond, and the 307 trenches received the highest individual Hazard Ranking System scores on the Hanford Site. The process trenches, which comprise the active 300 Area liquid waste disposal facility, are also located within this unit. Each of these infiltration ponds and trenches received a wide variety of hazardous wastes from reactor fuel fabrication and laboratory support activities via the 300 Area process sewer system.

Other active liquid waste disposal facilities within this unit include the sanitary sewer system for the 300 Area, pits used to retain slurried coal flyash which is disposed of off the 300 Area once it is dried, water treatment plant backwash ponds, and the 307 retention basin. The retention basin is used to collect laboratory wastes for sampling to determine whether or not such wastes can be discharged to the 300 Area process sewer for disposal. Batches of waste too contaminated for disposal at the 300 Area were stored in tanks at the 340 complex until transported by tank truck for crib disposal in the 200 West Area.

Radioactive liquid waste transport and storage facilities within the 300-FF-1 Operable Unit include the 340 complex tank storage facility mentioned above, and the past and present radioactive liquid waste sewer systems.

Three solid waste burial grounds are included in this unit. These sites contain uncharacterized quantities of waste including uranium-contaminated solid waste, disposal pond soils, and coal flyash.

Twenty-eight unplanned releases are known to have occurred within the unit; however, 22 of these were releases into the chemical process sewer. These latter releases, therefore, were ultimately disposed of in the liquid waste disposal facility which was operational at the time of the incident. In addition, there have in all likelihood been releases as a result of leaks within the process and sanitary sewer systems although the extent of such releases are unknown.

Tables 3-2, 3-3, and 3-4 include known waste inventories as determined during past preliminary assessment/site inspection activities conducted on inactive waste sites at Hanford. Waste inventories are inexact due to the fact that the 300 Area process sewer receives waste from more than 50 buildings, including several research and development laboratories. Therefore, a variety of chemicals may have been discharged into the system at some point in time in at least laboratory quantities. The various unplanned released which found their way into the process sewer adds to the uncertainty of the inventories.

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Table 3-1. Waste Disposal, Transfer, and Storage Facilities Included in Operable Unit 300-FF-1 (Sheet 1 of 2)

| rocess Liquid Waste Disposal Transfer Facilities                   | <u>Periods of Use</u> | <u>Waste Şources</u>                                                                                                                                                 |
|--------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Process Sewer System                                               | 1943-Present          | Process wastes, i.e., cooling water, low-level radioactive wastes from fuel fabrication processes, laboratory and test-facility wastes, and process chemical spills. |
| South Process Pond (316-1)                                         | 1943-1975             | Process wastes, water treatment plant filter backwash.                                                                                                               |
| North Process Pond (316-2) 1948-1974Process sewage                 | e, coal flyash.       |                                                                                                                                                                      |
| 307 Retention Basins                                               | 1953-Present          | <pre>Łaboratory wastes, i.e., cooling water, seal water, an<br/>laboratory and test-facility wastes.</pre>                                                           |
| 307 Trenches (316-3)                                               | 1953-1963             | Laboratory wastes, sediments from 316-1, coal flyash.                                                                                                                |
| Process Trenches (316-5)                                           | 1975-Present          | Process sewage.                                                                                                                                                      |
| •<br>her Liguid Waste Disposal and Transfer Facilities             | Periods of Use        | Waste Sources                                                                                                                                                        |
| Sanitary Sewer System                                              | 1943-Present          | Sanitary sewage, cooling water, minute quantities of photochemical process wastes.                                                                                   |
| Ash Pits                                                           | 1943(?)-Present       | Slurried coal flyash.                                                                                                                                                |
| Retired Filter Backwash Pond<br>(East Basin of South Process Pond) | 1975-1987             | Water treatment plant filter backwash.                                                                                                                               |
| Filter Backwash Pond                                               | 1987-Present          | Water treatment plant filter backwash.                                                                                                                               |

Table 3-1. Waste Disposal, Transfer, and Storage Facilities Included in Operable Unit 300-FF-1 (Sheet I of 2)

| 0.120                                                 |                       |                                                                                                               |            |
|-------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------------|------------|
| Burial Grounds                                        | <u>Periods of Use</u> | <u>Waste Sources</u>                                                                                          |            |
| Burial Ground #4 (618-4)                              | 1955-1961             | Uranium-contaminated miscellaneous materials.                                                                 |            |
| Burial Ground #5 (618-5)                              | 1945-1962             | Burning pit for trash, including uranium-contaminated trash.                                                  |            |
| North Process Pond Scraping Disposal<br>Area (618-12) | 1949~1964             | Sediments from 316-2, coal flyash.                                                                            |            |
| ioactive Liquid Waste Transferred Storage Facilities  | Periods of Use        | Waste Sources                                                                                                 | טטב        |
| Retired Radioactive Sewer System                      | 1954-1975             | Radioactive wastes, i.e., radioactive wastes from fuel fabrication, laboratory, and test-facility operations. | -KL 88-    |
| Radioactive Sewer System                              | 1975-Present          | Radioactive wastes.                                                                                           | <u>.</u> . |
| 340 Complex                                           | 1954-Present          | Radioactive wastes.                                                                                           | DRAF!      |
| Hazardous Waste Storage Facilities                    | Periods of Use        | Waste Sources                                                                                                 |            |
| 340 Complex Hazardous Waste Staging Area              | 1954-Present          | Drummed waste oil storage, empty hazardous waste drum storage.                                                |            |
| 332 Hazardous Waste Staging Area                      | 1983-Present          | Small-container hazardous waste storage.                                                                      |            |

Table 3-2. Estimated Non-Radiological Chemical Waste Inventory for the South Process Pond

| Total | Volume     | of | Liquids | Disposed: | 10,000,000 | m3             |
|-------|------------|----|---------|-----------|------------|----------------|
| Chemi | <u>cal</u> |    |         |           |            | <u>Quantit</u> |

| <u>Chemical</u>                                                                                                                           | Quantity (kg)                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| beryllium cadmium chromium copper fluoride lead mercury nickel nitrate nitrite nitric acid silver sodium sodium aluminate sodium silicate | Quantity (kg)  40 80 5,000 60,000 7,000 4,000 60 10,000 1,000,000 900,000 1,000,000 2,000,000 2,000,000 1,000,000 1,000,000 1,000,000 |
| trichloroethylene<br>uranium<br>zinc                                                                                                      | 100,000<br>100,000<br>40,000<br>5,000                                                                                                 |

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Table 3-3. Estimated Non-Radiological Chemical Waste Inventory for the North Process Pond

| Chemical         Quantity (kg)           beryllium         30           cadmium         60           chromium         3,000           copper         50,000           fluoride         5,000           lead         2,000           mercury         40           nickel         8,000           nitrate         800,000           nitrite         700,000           nitric acid         900,000           silver         900,000 | Total Volume of Liquids Disposed:                                                                                                                                          | 10,000,000 m <sup>3</sup>                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| cadmium       60         chromium       3,000         copper       50,000         fluoride       5,000         lead       2,000         mercury       40         nickel       8,000         nitrate       800,000         nitrite       700,000         nitric acid       900,000                                                                                                                                                | <u>Chemical</u>                                                                                                                                                            | Quantity (kg)                                                                                                                                                      |
| sodium       1,000,000         sodium aluminate       2,000,000         sodium hydroxide       800,000         sodium silicate       90,000         trichloroethylene       100,000         uranium       30,000         zinc       3,000                                                                                                                                                                                        | cadmium chromium copper fluoride lead mercury nickel nitrate nitrite nitric acid silver sodium sodium aluminate sodium hydroxide sodium silicate trichloroethylene uranium | 60<br>3,000<br>50,000<br>5,000<br>2,000<br>40<br>8,000<br>800,000<br>700,000<br>900,000<br>900<br>1,000,000<br>2,000,000<br>800,000<br>90,000<br>100,000<br>30,000 |

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Table 3-4. Estimated Non-Radiological Chemical Waste Inventory for the 307 Trenches

| Chemical         Quantity (kg)           beryllium cadmium cadmium corporation copper         1,000           copper copper         20,000           fluoride fluoride lead mercury nickel silver anium copper         3,000           silver anium copper silver anium copper co | Total Volume o                                                      | f Liquids Disposed: | 1,000,000 m <sup>3</sup>                                              |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------|--|
| cadmium       20         chromium       1,000         copper       20,000         fluoride       2,000         lead       600         mercury       10         nickel       3,000         silver       300         uranium       10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <u>Chemical</u>                                                     |                     | Quantity (kg)                                                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | cadmium chromium copper fluoride lead mercury nickel silver uranium |                     | 20<br>1,000<br>20,000<br>2,000<br>600<br>10<br>3,000<br>300<br>10,000 |  |

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Table 3-5 contains estimates of the various types and quantities of substances that could have been potentially discharged into the 307 trenches. A similar list of chemicals could be expected to have been discharged into each of the other major liquid waste disposal facilities as well.

Administrative measures, taken in 1985, have eliminated routine discharges of all hazardous and dangerous wastes to the active process trenches.

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**Table 3-5.** An Estimate of Chemicals Potentially Discharged to the 300 Area Process Trenches Prior to February 1, 1985

#### Intermittent Discharges Later Discharges\* <kqs <Grams ammonium bifluoride benzene 30 kg/mo\*\* copper antimonv carbon tetrachloride detergents <30 kg/mo\*\* chromium ethylene glycol arsenic <200 1/mo barium chlorinated benzenes hydrofluoric acid 100 kg/mo cadmium degreasing solvents nitrates <2000 kg/mo\*\* dioxane formaldehyde nitric acid <300 1/mo dioxint formic acid sodium hydroxide <300 1/mo hexachlorophene hydrocyanic acid paint solvents <100 1/mo pyridine kerosene photo chemicals <700 1/mo selenium & compounds lead sodium chloride 75 ton/yr\*\* uranium 20 kg/mo\*\* thiourea methyl ethyl ketone perchloroethylene misc. laboratory 450 1\*\*\* mercury chemicals napthalene 300 1\*\*\* heating oil nickel phenol silver sulfuric acid tetrachloroethylene (perchloroethylene) toluene tributylphosphate (paraffin hydrocarbon solvents) 1,1,1-trichloroethane (methyl chloroform) trichloroethylene

- † Included only because of the potential for dioxin to exist as a trace impurity in chlorinated benzenes.
- \* These discharges, except for the spills, were relatively continuous.

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\*\* These materials are still discharged.

xylene

\*\*\* Known spills.

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#### 4.0 SCOPE OF WORK AND POTENTIAL HAZARDS

While the information presented in Section 3 above is believed to be representative of the constituents and quantities of wastes at the time of discharge, the present chemical nature, location, extent, and ultimate fate of these wastes in and around the liquid disposal facilities are largely unknown. The emphasis of the remedial investigation in the 300-FF-I Operable Unit will be to characterize the nature and extent of contamination in the vadose (unsaturated subsurface soil) zone, groundwater, and sediments and waters of the Columbia River.

#### 4.1 WORK TASKS

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A surface radiation survey will be conducted in the vicinity of the process ponds and hot spots will be marked.

A ground penetrating radar survey will be conducted at burial grounds #4 and #5.

An electromagnetic survey will be conducted in an effort to detect leaks along the process sewer lines and the retired radioactive sewer.

The electromagnetic survey at the retired radioactive sewer will be followed up with a soil tracer gas survey. The pipeline will be pressurized with a unique tracer gas to attempt to locate any points of leakage in the system.

Soil boreholes will be installed and soil samples will be taken in the vicinity of each of the process liquid waste disposal facilities, and at any potential problem areas identified by the above survey procedures.

Groundwater seepage into the Columbia River, river sediments and river water will be sampled adjacent to the 300-FF-1 Operable Unit.

Columbia River water samples will be collected at the intakes to the City of Richland municipal water supply and 300 Area water supply.

Groundwater samples will be taken from existing wells. Additional wells will be installed at new locations and/or screened at different depths at existing locations to further characterize groundwater contamination and migration. Soil samples will be collected during drilling.

Ambient air sampling will be conducted to determine whether or not fugitive dust from the process ponds and trenches is impacting air quality.

An on-site biological survey will be performed to assess the potential for impacts to any endangered, threatened, economically important, or significant human food chain component species.

These will be real-time determinations made by the on site RPT (radiation protection technologist) based on criteria specified in the Radiation Work Permit (RWP).

#### 4.2 POTENTIAL HAZARDS

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Table 4-1 presents a list of known or suspected radiological hazards. Chemical contaminants and approximate quantities released were previously presented in Tables 3-2 through 3-5 above. In spite of the rather extensive list of substances known or suspected to have been released within the 300-FF-1 Operable Unit, extensive soil and groundwater sampling conducted to date indicate that chemical contaminants of potential concern are chromium, and volatile organics including trichloroethylene (TCE), perchloroethylene (PCE), and methylene chloride and PCBs (polychlorinated biphenyls). The allowable exposure limits and hazards associated with these chemicals are shown in Table 4-2.

As discussed above, this project will involve the following:

- a. Drilling shallow boreholes directly adjacent to liquid waste disposal ponds and trenches, and soil sampling;
- b. Drilling and well installation, and soil and groundwater sampling in areas known or suspected to contain hazardous chemical substances, toxic metals, and radioactive materials.

The degree of the potential occupational hazards are expected to be similar for each of the designated tasks but the likelihood of encountering hazardous chemical or radioactive substances will clearly be greatest during intrusions into and through the strata in the vicinity of the liquid waste disposal facilities.

Potential hazards include:

- 1. External radiation (gamma and to a lesser extent, beta irradiation) from radioactive materials in the soil.
- 2. Internal radiation due to radionuclides present in contaminated soil entering the body by ingestion or through open cuts and scratches.
- 3. Internal radiation due to inhalation of particulate (dust) contaminated with radioactive materials.
- 4. Inhalation of toxic vapors or gases such as volatile organics or ammonia.
- 5. Inhalation or ingestion of particulate (dust) contaminated with inorganic or organic chemicals, and toxic metals.
- 6. Dermal exposure to soil and/or groundwater contaminated with radionuclides.
- 7. Dermal exposure to soil and/or groundwater contaminated with inorganic or organic chemicals, and toxic metals.
- 8. Physical hazards such as noise and heat stress.

Table 4-1. Known Radiologic Hazards

| <u>Radionuclide</u> | Type of Radiation                    |
|---------------------|--------------------------------------|
| 3 <sub>H</sub>      | Soft B- (18.6 kev)                   |
| 60 <sub>Co</sub>    | 312 kev B-; 1.17,<br>1.33 Mev Gammas |
| 90 <sub>Sr</sub>    | 540 kev B-                           |
| 99 <sub>Tc</sub>    | 292 kev β-                           |
| 137 <sub>Cs</sub>   | 510 kev ß- 661 kev<br>gamma          |
| 238 <sub>U</sub>    | 4 to 6 Mev alpha                     |
|                     |                                      |

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Table 4-2. Potential Chemical Hazards (Sheet 1 of 2)

| SUBSTANCE                                      | LIMI' | ESHOLD<br>T VALUE<br>WEIGHTED<br>ERAGE<br>mg/m3 | IDLH<br>p/m | MONITORING<br>/SAMPLING<br>METHOD | PRIMARY HAZARDS<br>AND SYMPTOMS                                                                                             | PROTECTION                                               |
|------------------------------------------------|-------|-------------------------------------------------|-------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Chromium(VI)<br>and Chromium<br>(VI) Compounds | _     | 0.05                                            |             | (*,1)                             | Toxic if inhaled, ingested or absorbed through skin. Irritation of eyes, respiratory tract, skin.                           | Protection levels will be determined by:                 |
| Polychlorinate<br>biphenyl                     | d     | 0.5                                             | 5           | (*,1)                             | Toxic if inhaled, ingested or absorbed through skin.                                                                        | 1. The estimated site inventory                          |
|                                                |       |                                                 |             |                                   | Irritation of eyes, skin.                                                                                                   | 2. Onsite conditions                                     |
|                                                |       |                                                 |             |                                   |                                                                                                                             | 3. Sampling results                                      |
|                                                |       |                                                 |             |                                   |                                                                                                                             | 4. Company standards                                     |
| Methylene-<br>chloride                         | 50    | 175                                             | 5000        | 11.7 HNU<br>or OVA                | Toxic if inhaled, ingested or absorbed through skin. Irritation of eyes, respiratory tract, skin, nausea.                   | Immediate actions will be listed in site specific PJSP'S |
| Trichloro-<br>ethylene                         | 50    | 270                                             | 1000        | HNU or OVA                        | Toxic if inhaled, ingested or absorbed through skin. Headache, vertigo, tremors, vomitting, irritation of eyes, dermatitis. |                                                          |

Table 4-2. Potential Chemical Hazards (Sheet 2 of 2)

| SUBSTANCE                | LIMI <sup>*</sup><br>TIME \ | ESHOLD<br>T VALUE<br>WEIGHTED<br>ERAGE<br>mg/m <sup>3</sup> | IDLH<br>p/m | MONITORING<br>/SAMPLING<br>METHOD | PRIMARY HAZARDS<br>AND SYMPTOMS                                                                                              | PROTECTION |
|--------------------------|-----------------------------|-------------------------------------------------------------|-------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------|
| Tetrachloro-<br>ethylene | 50                          | 335                                                         | 500         | HNU or OVA                        | Toxic if inhaled, ingested or absorbed through skin. Irritation of eyes, nose, and throat, nausea, flush, vertigo, headache. |            |

<sup>\*</sup> Downwind sampling station by Hanford Environmental Health Foundation; if needed.
1 No "Real Time" sampling available; however, dusty conditions during drilling or other activities may require protective upgrade. If necessary, personal air monitoring will be undertaken according to NIOSH methods.

- 9. Slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, etc. typical of every construction related job site.
- 10. Unknown and/or unexpected underground utilities.

#### 4.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

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The likelihood of significant exposure (100 milliroentgens/hour or greater) to external radiation is remote and can be readily monitored and controlled by limiting exposure time, increasing distance, and employing shielding as required.

Internal radiation via inhalation or inadvertent ingestion of contaminated dust is a realistic concern and must be continuously evaluated by the RPT. Appropriate respiratory protection, protective clothing, and decontamination procedures will be implemented as necessary to reduce potential inhalation, ingestion, and dermal exposure to acceptable levels.

Exposure to toxic chemical substances via the dermal exposure route is not expected to pose a significant problem for the designated tasks given the use of proper protective clothing. As specified below, at a minimum SWPs (protective coveralls) white Tyvek coveralls and rubber gloves will be required within the control zone at all times, and outside of the control zone whenever it is necessary to contact or handle contaminated or potentially contaminated soil, groundwater, tools, etc. The appropriate level of personal protective clothing and respiratory protection may vary from B-I for soil sampling during drilling operations, to D-3 for sampling Columbia River water. In general, all activities conducted within an exclusion zone will require a minimum level D-2 as described in Section 6 below, and all other sampling will require D-3. These levels of protection will be upgraded as appropriate based on real-time hazard evaluation and action levels discussed in Section 5.

High volume particulate samplers are in operation in and around the 300-FF-1 Operable Unit. Chemical exposure via inhalation of contaminated dust is not expected to pose a significant hazard due to the relatively low concentrations of chemicals in soil and low concentration of dust in the ambient air. Activities which result in high levels of airborne particulate i.e., dusty operations, will require respiratory protection as discussed below.

Similarly, airborne concentrations of toxic gases/vapors are not expected to exceed applicable TLVs. As mentioned above however, the interactions and fate of these compounds are not well characterized. The Site Safety Officer will periodically monitor airborne levels of toxic vapors and gases with an HNU-PI-101 and appropriate colorimetric detector tubes. Air monitoring with direct reading instruments will be carried out continuously in the event of the detection of breathing zone concentrations greater than background levels. Respiratory protection will be employed as appropriate. Warning levels and action levels, if different than those established in Section 5 below, will be designated in the Pre-Job Safety Plans.

The project manager must make every effort to identify any and all underground utilities in the vicinity of all intrusive operations such as drilling or trenching. Should the work crew encounter an unanticipated underground utility, work shall be halted until the nature and status of the line is determine.

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#### 5.0 ENVIRONMENTAL AND PERSONAL MONITORING

The site safety officer shall be present at all times during work activities. Air quality monitoring equipment will be used during the field activities to quantify exposure of vapors and gases which pose risks. This equipment is intended to be used to provide adequate warning and allow appropriate action to be taken to prevent harmful exposure to contaminants released into the work environment. The air monitoring program will consist of monitoring air for contaminant vapor/gases in the vicinity of boreholes and breathing zones, and monitoring the general area for radiation. An RPT must be on site at all times and will observe the action levels and procedures specified in the radiation work permit (RWP) and appropriate ALARA Plans. Core samples will also be monitored to determine levels of radioactivity and occupational risks prior to actual sample collection. As indicated above, the decision to modify the level of protection will be made by the Site Safety Officer, RPT and the Field Team Leader. This decision will be based on, but not limited to the following:

- Interpretation of organic vapor, gas and radiation detection instrument readings by RPTs and Health and Safety personnel.
- Visual observation such as wind, dust, discoloration, etc.
- Noticeable odors by the RPTs and Health and Safety Personnel.
- $\bullet$  Other sampling devices such as  $0_2$  and explosive level meters.
- Information specific to the individual sites (i.e., known or suspected chemical contaminants and levels of each).
- Physical characteristics of the work environment such as temperature and pH.

Air sampling may be required downwind of the referenced waste sites to monitor particulates and vapors prior to job start up. Siting of such sampling devices will be determined by Operational Health Physics, GEU Site Safety Officer and HEHF (if appropriate). Discrete sampling of ambient air within the work zone and breathing zone will be conducted using the HNU or OVA, radiation detectors and other methods as deemed appropriate (e.g., pumps with tubes, O<sub>2</sub> meters, etc.). The following standards will be used in determining critical levels:

- Radionuclide concentrations in air, DOE Order 5480.1b Chapter XI
- Threshold Limit Values (TLV) (American Conference of Governmental Industrial Hygienists)
- Occupational Safety and Health Standards, 29 CFR 1910.120
- NIOSH Recommended Exposure Levels (RELs).

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#### 5.1 PCBS

While polychlorinated biphenyls are not known to have been released to 300-FF-1 ponds, PCBs have been detected in soil at concentrations up to approximately 40 parts per million. PCBs are non-volatile and do not constitute an inhalation hazard at concentration levels of 40 p/m in soil. For example, the TWA TLV for 54% chlorodiphenyl is 0.5 mg/m $^3$ . Assuming an extremely conservative 8 hour average airborne particulate concentration of 10 mg/m $^3$  and 100 p/m PCBs in soil, the maximum concentration in air may be estimated:

$$\frac{10 \text{ mg soil}}{\text{m}^3 \text{ air}} \times \frac{100 \times 10^{-6} \text{ mgPCB}}{\text{mg soil}} = .001 \text{ mg/m}^3$$

While this is substantially below the TWA for inhalation risks, employees must conscientiously observe the protective clothing and personal hygiene guidelines and protective clothing requirements specified in Section 2.1 above and 6.1 below.

#### 5.2 CHROMIUM

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Chromium has been detected in the south pond sediments at concentrations of 500 p/m. At this concentration chromium is not expected to be an inhalation hazard. The TWA TLV is  $0.05~\text{mg/m}^3$ . Assuming that the entire 500 p/m is hexavalent chromium, the airborne concentrations for chromium may be estimated following the method used for PCBs above.

Again assuming 10 mg soil/ $m^3$  air and 500 p/m hexavalent chrome in soil:

$$\frac{10 \text{ mg soil}}{m^3 \text{ air}} \times \frac{500 \times 10^{-6} \text{ mgCr}}{mg \text{ soil}} = .005 \text{ mg/m}^3$$

It is expected that protective measures for radionuclides will provide an adequate level of protection for hexavalent chrome. If environmental sampling indicates higher concentrations than expected, personal air sampling for hexavalent chrome will be conducted as necessary to fully characterize the inhalation hazard. Until actual contamination levels are determined, whenever windblown airborne fugitive dust is visible within the work area, employees within the exclusion zone shall don air purifying respirators with dust/mist filters, or work within the exclusion zone which involves disturbing the soil surface shall temporarily cease and employees shall leave the exclusion zone and move upwind.

#### 5.3 VOC MONITORING .

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The designated Site Safety Officer shall have an HNU-PI-101 or Foxboro OVA on site at all times and will establish "background readings" well upwind of any excavation, spoils pile, borehole, etc. An 11.7 eV probe is required in the HNU to detect methylene chloride. Calibration of the HNU shall be checked daily against 100 p/m isobutylene as calibration of, or as specified on the individual bottle of calibration gas.

| Lamp<br>Energy (eV) | Span<br>Setting | Acceptable<br>Reading (p/m) |
|---------------------|-----------------|-----------------------------|
| 9.5                 | 1.0             | 50 - 60                     |
| 10.2                | 9.8             | 50 - 60                     |
| 11.7                | 5.0             | 60 - 70                     |

The calibration of the Foxboro OVA must be checked daily. The instrument shall read between 8 and 10 p/m on the "lX" scale in response to 9 p/m methane with the "gas select" setting at 3.0.

Any consistent readings in the breathing zone that are perceptibly above the upwind background level for more than five minutes shall be the action level for donning half face air purifying respirators equipped with organic vapor acid gas cartridges. Cartridges will be replaced after each day of use or immediately upon any indication of "break through", whichever is less.

Any readings consistently greater than 5 p/m above background for 10 minutes or greater than 10 p/m other than for a brief peak, will be the action level for either temporarily discontinuing work, or upgrading the level of respiratory protection to "Level B" SCBA's or airlines as appropriate.

#### 5.4 AIRBORNE RADIOACTIVE MATERIALS AND RADIOACTIVE MONITORING

An on-site RPT will monitor airborne radioactive contamination levels and external radiation levels. Action levels will be consistent with DACs (derived air concentrations) and applicable guidelines as specified in the OHP (Operational Health Physics) Radiation Protection Manual (WHC-CM-4-10).

Appropriate respiratory protection shall be required when conditions are such that the airborne contamination levels may exceed an 8 hour DAC, i.e., the presence of high levels of uncontained, loose contamination on exposed surfaces or operations which may raise excessive levels of dust contaminated with airborne radioactive materials, such as excavation and/or drilling under extremely dry conditions.

Specific conditions requiring the use of respiratory protection due to radioactive materials in air will be incorporated into the RWP. If, in the judgment of the RPT, any of these conditions arise, work shall cease until appropriate respiratory protection is provided.

#### 6.0 PERSONAL PROTECTIVE CLOTHING AND RESPIRATORY PROTECTION

The following scheme will be used to designate the required level(s) of personal protective equipment and respiratory protection: The alphabetical designations "B," "C," and "D," shall refer to levels of respiratory protection namely pressure-demand air supplying respirators with escape provisions, air purifying respirators, and no respiratory protection, respectively. Since potential dermal exposure hazards may independently require a wide variety of personal protective clothing, regardless of an approved level of respiratory protection, the numerical designations "1," "2," and "3" will be used to specify the level of protective clothing that is to be employed i.e., the level of protective equipment can be completely defined by a designation of "C-2," "B-1," etc. as described below.

#### 6.1 PERSONAL PROTECTIVE EQUIPMENT

The level of personal protective equipment required initially at the site during excavation, drilling, and sampling activities will be D-3 which must include the following:

- 1. Cloth coveralls (SWPs)
- 2. Steel toed rubber boots
- 3. Safety glasses or safety goggles
- 4. Hard hat

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- NBR (nitrile-butyl rubber) or Neoprene rubber outer gloves where appropriate
- 6. Leather work gloves where appropriate
- 7. Inner gloves of PVC or latex rubber

If employees find that there is a likelihood of being splashed with mud or groundwater, the level of protective clothing shall be upgraded to Level D-2 and shall include a waterproof 1 or 2 piece Saranex or Chemrel suit. Gloves shall be worn whenever it is necessary to contact or handle wet soil, groundwater, or any other potentially contaminated implements or materials. The level of protective clothing shall be upgraded to "1" as described below if there is the likelihood of dermal exposure to unknown contaminants or to substances known to be toxic by the dermal exposure route.

Air purifying respirators shall be immediately available and Level D respiratory protection shall be immediately upgraded to Level C or Level B as appropriate, if indicated by real-time conditions, site monitoring and the action levels specified in Section 5 above. No changes to the specified levels shall be made without the approval of the Site Safety Officer, the RPT, and the Field Team Leader.

#### LEVEL D-2 PROTECTION

- 1. Cloth coveralls (SWPs), surgical gloves, canvas or rubber gloves as appropriate, rubber shoe covers
- 2. One piece tyvek suit or waterproof Saranex or Chemrel suit as appropriate
- 3. Steel toed rubber boots or steel toe leather boots, as appropriate

- 4. Outer boot covers (booties)
- 5. Safety glasses or safety goggles if splash hazard exists
- 6. Hard hat
- 7. NBR (nitrile-butyl rubber) or neoprene rubber outer gloves
- 8. Inner gloves of PVC or latex rubber

#### LEVEL C-2 PROTECTION

D-2 plus air purifying respirator.

#### LEVEL B-2 PROTECTION

D-2 plus pressure demand supplied-air respirator. Supplied air must be Grade "D" or better, "Breathing Quality Air."

#### LEVEL C-1 PROTECTION

1. Hard hat

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- 2. Cotton coveralls (SWPs) or inner tyvek suit
- 3. Inner gloves of PVC or latex taped to inner tyvek
- 4. Hooded one piece waterproof outer suit (Saranex, Chemrel or PVC)
- 5. Outer NBR gloves taped to outer suit
- 6. Solvent resistant steel toed rubber boots taped to outer suit
- Outer boot covers (booties)
- 8. Full-face air purifying respirator

#### LEVEL B-1 PROTECTION

C-1 with pressure demand supplied-air respirator in place of full-face air purifying respirator.

#### 6.2 HEAT STRESS

Working in protective clothing can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life threatening condition. If temperatures at the site are above 65°F, the wet bulb globe temperature shall be monitored to asses the potential for heat stress. Work/rest periods will be adjusted according to the standards stated in current Threshold Limit Values (TLV) (American Conference of Governmental Industrial Hygienists). Sufficient cool water and disposable drinking cups will be provided in the rest area. Engineering controls such as solar shielding, etc., will also be applied when and where appropriate.

If the wet bulb-globe temperature exceeds 77°F (25°C), employees shall use the "buddy system" to monitor each other's pulse rate at the start of each rest period. If the pulse rate exceeds 110 beats per minute, the employee shall take his or her oral temperature with a clean disposable colorimetric oral thermometer. If the oral temperature exceeds 99.6°F, the next work period shall be shortened by one third. The pulse rate and oral temperature shall be monitored again at the beginning of the next rest period; and if the oral temperature exceeds 99.6°F, the work period shall again be shortened by one third, etc., until the oral temperature is below 99.6°F.

All employees are to be alert to the possibility and symptoms of heat stress. Should any of the following symptoms occur: extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, pale clammy skin, the employee is to immediately leave the work area, rest, cool off, and drink plenty of cool water. If the symptoms do not subside after a reasonable rest period, the employee shall notify the Project Supervisor or Site Safety Officer and seek medical assistance.

#### 6.3 HYPOTHERMIA

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Working in extreme cold and exposed areas may create a risk of hypothermia. All employees should be alert to the symptoms, which include increasing disorientation and impaired judgement, shivering, weakness, numbness, drowsiness, and low body temperature. Unconsciousness may result if the symptoms are undetected. Should any employee observe such symptoms, escort the victim out of the work area to a vehicle or other heated, protected area. Treat for shock; keep the victim warm and quiet, and seek medical assistance immediately.

#### 7.0 SITE CONTROL

The Field Team Leader, Site Safety Officer and Radiation Protection Technologist are designated to coordinate access control and security on the site. Special site control measures will be necessary to restrict public access to drilling operations located outside of fenced areas of the 300-FF-1 operable unit. A temporary Exclusion Zone will be established (a minimum of a 25 foot radius) at each digging or drilling location. The Exclusion Zone will be clearly marked with radiation zone rope and Radiation Area signs. The size and shape of the exclusion zone will be dictated by the types of hazards expected, the climatic conditions and specific drilling and sampling operations required. The ground surface of the area immediately around the drill hole, the corridors to the command post and the decontamination area and the escape route will be covered with appropriate material to reduce contamination of personnel and equipment. Exclusion Zone boundaries will be increased or decreased based upon results of field monitoring, environmental changes or work technique changes. The site Radiation Work Permit and the contractor's standard operating procedures for radiation protection will also dictate the boundary size and shape. Portable sanitation facilities shall be located outside of the Exclusion Zone. NO unauthorized person shall be allowed within the exclusion zone and no authorized person shall be allowed within the exclusion zone unless he or she is equipped with the required level of personal protective equipment and respiratory protection. All team members must be surveyed for radioactive contamination upon leaving the exclusion zone.

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The on site command post and staging area will be established near the Exclusion Zone on the upwind side as determined by an onsite windsock if physically possible. Exact location for the Command Post is to be determined just prior to start of work. Vehicle access, availability of utilities (power and telephone), wind direction and proximity to sample locations should be considered in establishing Command Post location.

#### 8.0 DECONTAMINATION PROCEDURES

Remedial investigation activities will require intrusion into areas of known chemical and radiological contamination. Consequently it is likely that personnel and equipment will be contaminated with hazardous chemical and radiological substances.

During drilling and sampling activities at the site, field workers may become contaminated in various ways, many of which are not readily apparent to the individual. Potential sources of contamination include but are not limited to airborne vapors, gases, dust, mists and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. All personnel who enter the exclusion zone will be required to go through decontamination procedures upon leaving the zone. Decontamination areas shall be located upwind of the work area. The procedures discussed below are intended to be compatible with procedures specified in the Environmental Investigation Instruction for decontamination.

Decontamination procedures shall be consistent with Level B and Level C decontamination protocol. It is anticipated that most of the decontamination work will require the following equipment and facilities:

- Decontamination garbage/dirty equipment bags;
- Decontamination pad/corridor cover (Kraft paper);
- Emergency response pressurized water tank with wand and adjustable spray nozzle;
- 4. Bagging and taping material;
- 5. Emergency water deluge and eyewash bottles;
- Detergent, brush and bucket;
- 7. Barrels;

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- 8. Step out pads;
- 9. Sponges, wipes and rags;
- 10. Tables and stands.

Specific decontamination procedures will be provided in pre-job safety plans.

#### 8.1 PERSONNEL DECONTAMINATION

All personnel who access the exclusion and contamination reduction zones of the project will process through decontamination at the end of any given work shift. A decontamination corridor will be established within the exclusion zone for each task of the campaign. Clothing that is disposable will be removed in such a manner that outer layers are removed first and

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placed in sealed containers. Non-disposable clothing such as SWPs that can be cleaned will be removed, bagged and sent to the laundry. After removing outer protective clothing, each team member must be surveyed by qualified and authorized personnel prior to proceeding to an uncontrolled area. When radioactive contamination is detected, "Radiation Protection" shall be notified and the person shall be escorted by an RPT to an appropriate area for decontamination. At the RPT's direction, nosewipe analyses, whole body counts, and urine samples may be required to determine the extent of contamination.

#### 8.2 EQUIPMENT DECONTAMINATION

Equipment decontamination methods will generally consist of washing or steam cleaning with a detergent/water or other decontamination solution as specified in the Field Sampling Plan. Rinsing with a dilute nitric acid solution may be necessary to remove metal oxides and hydroxides. Field contamination of drilling equipment, where applicable, shall be performed within impoundments in the Decontamination Zone to ensure that all wash liquids are captured.

Downhole drilling equipment shall be decontaminated prior to use on another borehole and/or as required to assure the safety of personnel and prevent cross contamination of samples.

Equipment which is radiologically contaminated beyond the limits specified in the RWP shall not be decontaminated in the field. Such equipment shall be transported to the 2705-T building for decontamination prior to reuse.

#### 8.3 SAMPLING AND MONITORING EQUIPMENT

All possible measures should be taken by personnel to prevent or limit the contamination of any sampling and monitoring equipment used. Sampling devices will become contaminated. In general, air monitoring instruments will not be contaminated by chemicals unless splashed or set down on contaminated areas. Any delicate instrument that cannot be easily decontaminated should be protected while it is being used by placing it in a bag and using tape to secure it around the instrument. Openings in the bag can be made for sample intake, electrical connections, etc. Personnel performing field maintenance procedures on air monitoring instruments should be aware of the fact that instruments may become contaminated internally if air containing high concentrations of radioactive particulate is drawn through the instrument. Foreign material which collects within the probe tip and on the face of the lamp on the HNU photoionization detector may be chemically or radioactively contaminated and should be handled appropriately when disassembling the probe or cleaning the lamp. A similar situation exists with the readout probe and metallic frit filters in the sampling line of the OVA organic vapor analyzer. All instruments and equipment must be surveyed for the purpose of radiological contamination control prior to removal from the exclusion zone. Items with detectable levels of contamination must be controlled as radioactive material or controlled or regulated equipment.

Sampling devices require special cleaning and decontamination (see Sampling Plan). When appropriate, disposable sampling equipment will be used to eliminate the need for decontamination liquids.

#### 8.4 RESPIRATORY PROTECTION EQUIPMENT

Respiratory protection will be used based upon the level of protection required for each job. There is a high potential for hoses to become contaminated; therefore, where possible and necessary hoses should be covered with plastic. If grossly contaminated, they may have to be discarded. Cleaning and decontamination of face pieces will be performed by the mask cleaning station (i.e., Laundry). Maintenance of special respiratory protection equipment (i.e., SKA PAK) is performed by Personal Protective Equipment Unit in MO-412, 200 West Area.

#### 8.5 HEAVY EQUIPMENT

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All possible measures will be taken to prevent or limit the contamination of heavy equipment. Those parts of drilling equipment that become contaminated, such as auger flights, will be double bagged and taken to the 2705-T building for decontamination before reuse to minimize personnel contamination potential and cross contamination of samples between boreholes.

#### 9.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

The following procedures have been established to deal with emergency situations that might occur during drilling or sampling operations. As a general rule, in the event of an unanticipated, potentially hazardous situation as indicated by instrument readings, visible contamination, unusual or excessive odors, etc., team members shall temporarily cease operations, and move upwind to a predesignated safe area.

A two way radio will be operational and be manned by the Field Team Leader to maintain contact with the team's base station. Personnel in the Exclusion Zone will maintain line-of-sight with the Field Team Leader. Any failure of radio communications will require evaluation of whether personnel shall leave the Exclusion Zone. Communications from rig to rig or site to site will also be provided in order that the Site Safety Officer or Field Team Leader can respond accordingly. In addition, a series of three (3) one-second horn blasts from a truck in the support zone is the emergency signal for all personnel to the leave the Exclusion Zone.

The following standard hand signals will be used in all cases:

Hand gripping throat

Out of air, can't breathe

Grip partner's wrist or both hands around waist

Leave area immediately

Hands on top of head

Need assistance

Thumbs up

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OK, affirmative

Thumbs down

No, negative

The Site Safety Officer is directly responsible for providing safety recommendations on the site to the Site Emergency Coordinator. The Site Emergency Coordinator for the 300-FF-1 drilling operations will be the Field Team Leader. The Site Safety Officer will call the Fire Department prior to commencing work on each site.

The Site Emergency Coordinator will be responsible for the evacuation, emergency treatment, emergency transport of field personnel as necessary, and notification of the appropriate Hanford Facility emergency response units and management staff.

Emergency communications will be maintained during all on site field activities by two way radio contact. If an emergency occurs such as fire or explosion, all on site personnel should exit the site in an upwind direction and assemble in a predesignated area. All emergency response actions for each job will be covered in the tail gate meeting with the pre-job safety plan. If an on site injury occurs, team members should employ the following procedures.

If able, the injured person should proceed through decontamination to the nearest available source of first aid. If the injured party is extremely muddy, remove outer garments and if necessary, wash the injured area with soap and water.

Upon notification of a serious injury in the Exclusion Zone, the emergency signal of three one-second horn blasts will be sounded. All site personnel will assemble at the decontamination line. The Site Safety Officer and Field Team Leader should evaluate the nature of the injury and the extent of decontamination possible prior to movement of the injured person to the support area. No person should reenter the Exclusion Zone until the cause of the injury is determined and measures taken to prevent recurrence.

If the victim is unable to walk, but is conscious and there is no evidence of spinal injury, escort or transport the injured person through decontamination procedures to the nearest first aid facility (see Figure 9-1). If the victim cannot be moved without causing further injury such as in the case of a severe compound fracture, take necessary emergency steps to control bleeding and immediately call for medical assistance as discussed below.

If the victim is unconscious or unable to move, <u>Do Not Move the Injured Person Unless Absolutely Necessary to Save His or Her Life</u>, until the nature of the injury has been determined.

If there is any evidence of spinal injury do not move the victim unless absolutely necessary to save his or her life. Administer rescue breathing if the victim is not breathing, control severe bleeding and <u>immediately</u> contact the Hanford Patrol (811) by phone or radio on Channel 2.

Should any employee exhibit erratic behavior, or fall unconscious due to apparent heat stroke, the emergency three horn blasts shall be sounded and the field team leader shall immediately call for an ambulance. All personnel within the exclusion zone shall immediately proceed through decontamination with the victim, as follows:

- 1. Remove victim's outer protective clothing and discard
- 2. Remove own outer protective clothing and discard

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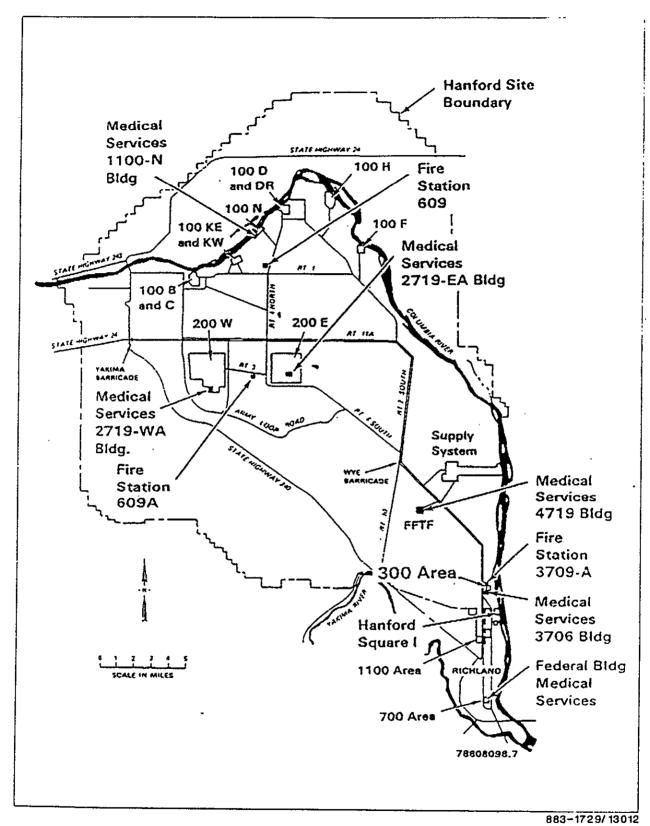
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- 3. Remove victim's inner protective clothing and discard
- 4. Remove own inner protective clothing and discard
- 5. Place victim in shade, open victims clothing and cool the victim by wetting and fanning. Place ice pack (if available) behind neck and/or on forehead of victim.

Remember, heat stroke is an immediately life threatening situation. Treat the situation accordingly.

In extremely cold or exposed working situations, if an employee shows increasing disorientation or any other symptoms of hypothermia, follow the basic emergency procedures for heat stroke, except remove the victim to a heated vehicle or other protected area. Keep the victim warm and quiet and summon an ambulance immediately.



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Figure 9-1. Location of Hanford Emergency Facilities

#### 9.2 PROCEDURE FOR PERSONAL INJURY IN THE SUPPORT AREA

Upon notification of an injury in the Support Area, the Field Team Leader and the Site Safety Officer will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance or safety of site personnel, operations may continue, with initiation of first aid and summoning of medical assistance as discussed above. If the injury increases the risk to others, the emergency signal of three one-second horn blasts will be sounded and all site personnel shall move to the decontamination area for further instructions. Activities on site will stop until the hazardous condition (if any) is evaluated and reduced to an acceptable level.

#### 9.3 PROCEDURES FOR FIRE AND EXPLOSIONS

The dry chemical fire extinguishers which are required on all field vehicles are effective for fires involving ordinary combustibles such as wood, grass, etc., flammable liquids, and electrical equipment. They are appropriate for small, localized fires such as a drum of burning refuse, a small burning gasoline spill, a vehicle engine fire, etc. No attempt should be made to use the provided extinguishers for well established fires or large areas or volumes of flammable liquids.

In the case of fire, prevention is the best contingency plan. Smoking in the Exclusion Zone is strictly prohibited and smoking materials where permitted should be extinguished with care.

- In the event of a fire or explosion:
- Immediately notify site emergency personnel and the local fire department by contacting the Hanford Patrol by phone at 811 or by radio on station 1 to relay message.
- If the situation can be readily controlled with available resources without jeopardizing the health and safety of yourself or other site personnel, take immediate action to do so. If not:
- Isolate the fire to prevent spreading if possible.
- 4. Clear the area of all personnel working in the immediate vicinity.
- 5. Upon notification of a fire or explosion on site, the emergency signal of three one-second horn blasts will be sounded and all site personnel will assemble upwind of the fire at the decontamination line. The fire department will be called and all personnel will move to a safe distance from the involved area. Again, based on the individual tail gate meetings, a decision to send all personnel immediately out of the Exclusion Area may be an option.

#### 9.4 PROCEDURE FOR PERSONAL PROTECTIVE EQUIPMENT FAILURE

If any site worker experiences a failure or alteration of protective equipment that may jeopardize the level of protection provided by that equipment, that person and his/her buddy shall immediately procede through decontamination and leave the Exclusion Zone. Reentry shall not be permitted until the equipment has been repaired or replaced, or the conditions leading to the problem are adequately evaluated and corrected.

### 9.5 PROCEDURE FOR FAILURE OF OTHER EQUIPMENT

If on-site monitoring equipment fails to operate properly, the Field Team Leader and Site Safety Officer shall be notified and then determine the effect of the failure on continuing operations. If the failure may compromise health and safety procedures or jeopardize the safety of personnel, all personnel shall leave the Exclusion Zone until the equipment is reparied or replaced.

#### 9.6 EMERGENCY ESCAPE ROUTES

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In the event that an emergency situation prevents exiting the Exclusion Zone by way of the decontamination area, exit the Exclusion Zone in any direction, preferably upwind, avoiding any barriers.

### 9.7 RESPONSE ACTION TO CHEMICAL EXPOSURE

If an injury to a worker is chemical in nature, the following first aid procedures are to be instituted as soon as possible:

- Eye Exposure If contaminated solid or liquid gets into the eyes, wash eyes at the site immediately with an emergency eye wash bottle. Proceed to the emergency eye wash station which will be provided in the field and wash eyes using large amounts of water. Obtain medical attention immediately by calling 811.
- Inhalation Exposure If a person breathes in large amounts of organic vapor, move the exposed person to fresh air at once. If breathing has stopped perform artificial respiration. If breathing and heart have both stopped, perform CPR. Obtain medical attention as soon as possible by calling 811. Keep the person warm and at rest until medical help arrives.
- Skin Exposure If contaminated solid or liquid gets on the skin, promptly use the deluge water unit, then wash contaminated skin using soap or mild detergent and water. If solids or liquid penetrate through the protective clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately if symptoms warrant by calling 811. If a person is contaminated b radioactive material, first aid will be conducted by normal skin decontamination procedures as defined in HPP-G-004-0001.

# ATTACHMENT 3 COMMUNITY RELATIONS PLAN

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#### 1.0 COMMUNITY RELATIONS PLAN

A Community Relations Plan (CRP) is currently being developed for the Hanford Site Environmental Restoration Program (ERP). Because community relations activities are so interrelated among operable units, a decision was made to develop a single CRP that will have the capability to address specific individual concerns associated with each operable unit, but will still provide continuity and general coordination of all the ERP activities with regard to community involvement. The site-wide CRP discusses Hanford Site background information, history of community involvement at Hanford, and community concerns regarding the Hanford Site. It also delineates the community relations program that the U.S. Department of Energy - Richland Operations Office, the U.S. Environmental Protection Agency - Region X Office, and the Washington Department of Ecology will cooperatively implement throughout the cleanup of all the operable units at the Hanford Site. All community relations activities associated with the 100-HR-1 Operable Unit work plan will be conducted under this overall Hanford Site CRP.

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# ATTACHMENT 4 DATA MANAGEMENT PLAN

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#### 1.0 INTRODUCTION AND OBJECTIVES

An extensive amount of data will be generated over the next several years in connection with the RI/FS process that will be conducted to evaluate and remediate hazardous waste sites at the Hanford Site. The quality of the data must be beyond reproach because they will be used to evaluate the need, select the method(s), and support the full remediation of the waste sites as agreed upon by the DOE, EPA, Ecology, and interested parties. Thus, a comprehensive plan for the management of this extensive amount of data is absolutely essential.

This plan describes a two-component data management system (DMS) for accessing and tracking the receipt, storage, and control of validated data, records, documents, correspondence, and other associated information. These components include the following:

• A computer based component

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• An administrative component to handle, store, and protect physical records and samples.

An all-inclusive DMS is not presently available for supporting the RI/FS work planned at the Hanford Site over the next several years. This Data Management Plan outlines the following:

- Types of data and information that are expected to be collected
- Currently available computer-based and administrative components
- Plans for developing any needed interim administrative components
- Plans for developing a comprehensive computer-based component that integrates selected existing and anticipated computer data bases
- Plans for establishing an information repository for maintaining the official paper-copy (hard-copy) records and physical samples associated with each operable unit.

Procedures for the system will be developed for directing project-authorized personnel as to the manner in which data are received, stored, tracked, amended, and disseminated so that a record of control is always maintained. These procedures will be developed to assure that the integrity of the data is maintained. The procedures will be provided in a detailed data system procedure manual that describes how data can be entered, accessed, processed, and amended so that a record of use and changes or modifications to the data is maintained. Access to the data base by all interested parties will allow access as described in the agreement being developed by DOE, EPA, and Ecology.

The data system procedures manual will include the procedures necessary for handling and tracking the information that must be maintained in the official (hard-copy) administrative record for each operable unit as well as physical paper-copy records and archived physical samples associated with each unit. It will also include procedures for operation and control of the

computer-based component of the system. Existing procedures will be either modified or used, or new procedures will be developed to address records management for the following general subject areas:

- Congressional inquires and hearings
- Discovery
- Remedial planning, investigation and feasibility study
- Remedial design and implementation
- EPA and State agency coordination
- Community relations
- Imagery (photographs, maps, illustrations, etc.)
- Enforcement activities
- Contracts

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Financial records.

An Environmental Data Management Plan is being prepared for submittal to DOE-RL by March 31, 1989. The plan will address development of the data . management system discussed here and will include as a task the development of the data system procedure manual mentioned above. The plan will detail requirements, procedures, and responsibilities for managing environmental data.

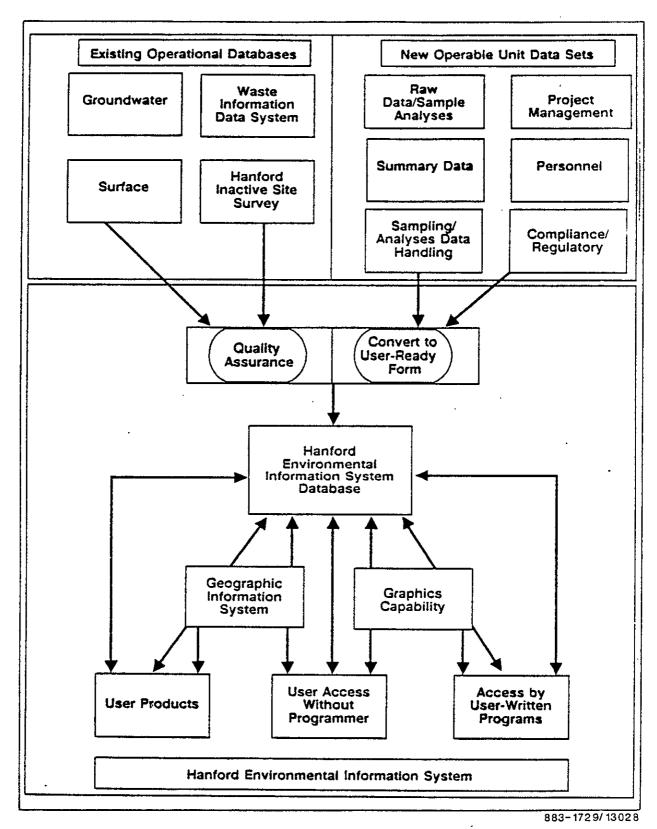
The computer-based component is the Hanford Environmental Information System (HEIS), currently being developed by PNL. HEIS will be used to manage the extensive amount of data that will be collected and generated during the RI/FS and site-remediation processes. The HEIS is a computer-based information system that is designed to receive, store, and provide for access to quality-assured data concerning Hanford Site environmental and regulatory issues. As shown in Figure 1-1, HEIS is an integrated data base designed to integrate existing operational data bases and provide facilities for data being gathered as part of the CERCLA process. This allows for accessing and evaluating the data that is collected and generated by the individual Hanford Site environmental data base programs [e.g., Hanford Ground Water Data Base (HGWDB), surface monitoring Program Data and Management System (PDMS), Waste Information Data System (WIDS), Hanford Inactive Site Survey (HISS)], while maintaining the integrity of the individual data bases.

The HEIS will provide the following:

User support capabilities

- A geographic information system (GIS)
- Integrated graphics support
- Comprehensive user access capabilities
- Access by personal computers via existing networks
- Security of the data bases.

The computer based component will serve to list and locate paper records and physical samples. The HEIS will maintain much of the various types of raw-site (operable unit) data, verified program and summary data, and results of approved analytical computer programs. The results of such analyses will be stored separately from the original data files.



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Figure 1-1. Framework of the Hanford Environmental Information System (HEIS)

The ability to enter data into raw data files will be restricted so as to maintain control of validated data. Any changes required to validate data will be procedurally controlled to restrict qualified data from being inadvertently or intentionally altered. All changes will be documented and maintained in the system.

The official paper-copy records (administrative record as well as other official paper-copy records) and archived physical samples will be maintained in designated areas that will be specified in the data system procedures manual. The designated areas will be designed such that they will meet all applicable protection and security requirements. Backup record copies will be maintained as necessary.

## 2.0 TYPES OF DATA TO BE COLLECTED AND ANALYZED

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Records and types of data to be tracked during the RI/FS process at Hanford Site are shown in Table 2-1. The "Raw Data" represents the actual field and laboratory measurements or observations that will be made during the RI/FS processes. The "Summary Data" represents the first-order analyses of the "Raw Data." "Program Tracking" includes information that is programmatic or administrative in nature. It represents the data that are required for the conduct of a project; however, it does not include the field or laboratory data.

To the extent possible, validated data gathered during RI/FS investigations will be kept separate from other Hanford Site project data. However, many of the ongoing Hanford Site projects will provide data that will undoubtedly be very useful for the Hanford Site RI/FS investigations. Data will be stored such that they may be accessed for analyses, the results of which will be stored separately.

A reference collection of applicable EPA, Ecology, DOE, and Hanford Site contractor documents, drawings and correspondence will be maintained to support site characterization and remedial investigation activities. The ARARS drawn from Federal and State requirements and standards will also be kept and updated in a timely manner. Compliance requirements will also be maintained and updated periodically.

# 3.0 DATA MANAGEMENT PLAN SCOPE RELATIVE TO OTHER REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN COMPONENTS

The DMS will receive and control validated data obtained through implementation of the 100-HR-1 Operable Unit Work Plan and the Field Sampling Plan (FSP), and Health and Safety Plan (HASP). The Quality Assurance Project Plan (QAPP) provides the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to assure quality data and results of analyses. The FSP provides the detailed

Table 2-1. Types of Remedial Investigation/Feasibility Study Information and Data to be Collected

|                                 | Site Characterization                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Raw data/sample analyses        | Groundwater samples Sediment samples Surface water samples Atmospheric samples Personnel exposure monitoring records Geophysical information Biota samples Site descriptive information (topography, geological and ecological features) Pilot/bench test data Engineering design data |
| Summary data                    | Analytical results of environmental media<br>by time, location, depth, contaminant, etc.<br>Health risk assessment results<br>Engineering test results<br>Graphic information system outputs                                                                                           |
| Sampling/analyses/data handling | Sampling schedule Sample collection procedures Field/laboratory notebooks Analyses scheduling Laboratory quality assurance/quality control Calibration tracking Instrument coordination Data entry procedures Data reduction, validation, storage and transfer procedures              |
| •                               | Program Tracking                                                                                                                                                                                                                                                                       |
| Project management              | Project schedule and milestones Project costs Equipment, personnel, and supplies scheduling Document tracking Subcontracts Project quality assurance/quality control procedures                                                                                                        |
| Personnel                       | Personnel training and qualifications<br>Occupational exposure reports<br>Personnel health and safety records                                                                                                                                                                          |
| Compliance/regulatory           | Applicable or relevant and appropriate requirements (ARARs)/screening levels Guidance document tracking Compliance issues Problem resolution                                                                                                                                           |

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logistical methods to be employed in selecting the location, depth, frequency of collection, etc., of media to be sampled and in methods to be employed to obtain samples of the selected media for cataloging, shipment, and analyses. The data that result from the analyses will be entered into the DMS for subsequent control and tracking. In a similar manner, data from field and bench tests of potential remedial techniques will be entered into the DMS. Procedural control for such testing will be found in the QAPP. Specific directions and logistical methods to be employed for field and bench testing will be provided prior to Phase II RI activities. Site and personnel health data needed to assure worker safety will be specified in the HASP, which will also specify the manner in which these data are to be obtained. Personnel health records will be protected as required by the Privacy Act and secured in such a way that only authorized personnel will have access to these data.

#### 4.0 PROCEDURAL CONTROL

The data management system will be procedurally regulated by the data systems procedure manual to be developed. A specific example relating to surface environmental monitoring is given in Figure 4-1.

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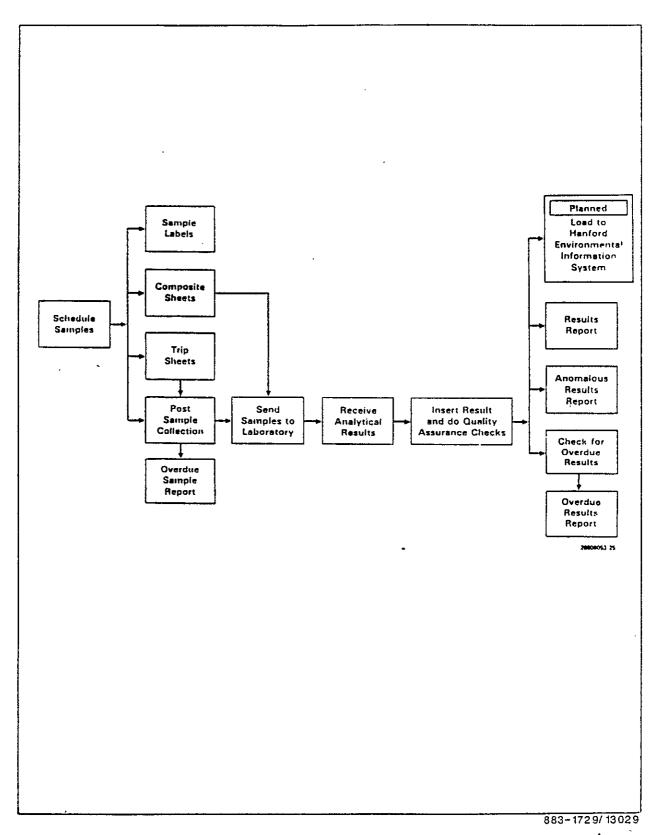
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#### 5.0 IDENTIFICATION OF EXISTING DATA BASE SYSTEMS

Several data bases are currently in use at the Hanford Site. These data bases were developed for a variety of different purposes and uses. However, much of the information and data-handling capabilities associated with these data bases is directly useful to RI/FS evaluation of the various operable units located on the Hanford Site. A listing of the existing data bases that are available is provided in Table 5-1.

Westinghouse Hanford maintains an Environmental Resource Center (ERC) that contains copies of environmental and pertinent Federal and Washington State regulations, documents that have been prepared and submitted to Ecology and EPA pertaining to the regulations, and correspondence in support of environmental matters. The ERC contains RCRA permit applications and closure plans as well as RI/FS work plans for individual Hanford Site operable units. Other information such as environmental laws, DOE orders, corporate policies, and case histories will also be added. A computer based indexing system is presently being developed and will allow rapid identification of appropriate documents, copies of which can be obtained from the ERC files. The ERC will contain copies of all correspondence with Ecology and EPA. This will include primary as well as secondary documents.



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Figure 4-1. Example Procedure for Collecting, Handling, and Analyzing Samples and for Entry of the Results

# Table 5-1. Existing Hanford Data Bases (Sheet 1 of 2)

|            | Data Base Name                                     | Information Type                                                                                                                                                                                         |
|------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | Hanford Groundwater Data Base<br>(HGWDB)           | Contains chemical and radionuclide analytical results for groundwater and sediment samples                                                                                                               |
|            | Program Data and Management<br>System (PDMS)       | Contains chemical and radionuclide analytical results of air, surface water, soil, vegetation, wildlife, and foodstuffs samples                                                                          |
| 4.         | Waste Information Data System (WIDS)               | Contains information on the physical and environmental characteristics of waste units at the Hanford Site (radioactive and hazardous chemicals)                                                          |
| LO.        | Hanford Inactive Site Survey (HISS)                | Contains detailed preliminary assessment/site inspection (PA/SI) information on individual waste sites at the Hanford Site                                                                               |
|            | Hanford Environmental<br>Compliance Report (HECR)  | Contains information on Hanford Site waste streams for tracking environmental compliance issues                                                                                                          |
| cylighese- | Environmental Compliance<br>Tracking System (ECTS) | Contains regulatory flowsheet information for tracking compliance with Federal, State, and local environmental regulations                                                                               |
| <b>O</b>   | Sample Preparation System (SPS)                    | Generates labels, reports, etc., for sampling preparation and contains information on facilities, location, and time of sampling and chain-of-custody information                                        |
|            | BWIP Technical Data System (BTDS)                  | Contains information on hydrological conditions and some geological data for the Hanford Site; also contains site characterization, hydrological data, hydrochemistry, stratigraphy and constituent data |
|            | Warehouse Inventory Management<br>System (WIMS)    | Keeps track of all the hazardous material purchased for use on the Hanford Site                                                                                                                          |

# Table 5-1. Existing Hanford Data Bases (Sheet 2 of 2)

| Flow Gemini - Environmental<br>Information System (HEHF's<br>Occupational Hazardous<br>Materials Exposure/Monitoring<br>System) | Contains information associated with onsite monitoring of exposures to hazardous materials for Hanford workers                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Gemini - Occupational<br>Health Information System<br>(HEHF's Medial Information<br>Tracking System)                       | Contains employee medical information                                                                                                                                                                                                                      |
| Material Safety Data Sheet<br>(MSDS) System                                                                                     | Contains information on chemicals found at Hanford. Currently this is a manual system operated by HEHF, but it is in the process of being computerized. This effort is being coordinated with the SARA Title III Right-To-Know Program at the Hanford Site |
| Occupational Radiation Exposure (ORE)                                                                                           | Contains personnel respiratory protection fitting, work restriction, and radiation exposure information                                                                                                                                                    |
| Quality Control Blind Standards<br>Data Base                                                                                    | Contains the results on spiked samples, replicate samples and interlaboratory comparisons                                                                                                                                                                  |
| Training Records Information System (TRIS)                                                                                      | Contains records on individual employee training records                                                                                                                                                                                                   |
| Commitment Control System (CCS)                                                                                                 | Tracks correspondence commitments. A network version is available.                                                                                                                                                                                         |

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#### 6.0 EVALUATION OF EXISTING DATA-BASE SYSTEMS

In general, the existing data bases in use on the Hanford Site were designed for specific purposes. They are not integrated to cover anticipated RI/FS needs. These existing data bases will provide supplementary, historical data to support the RI/FS process. The scope of each data base identified in Table 5-1 is discussed separately in the following paragraph.

The Hanford Groundwater Data base (HGWDB) is used to generate the annual "Groundwater Monitoring at Hanford" report. It also contains the Hanford Site's RCRA compliance-monitoring program's groundwater monitoring data. In addition, it has been modified to handle vadose zone (sediment) sample data.

The Program Data and Management System (PDMS) is generally used by the Hanford Site to generate the annual "Surface Environmental Monitoring at Hanford" report. It is an overall data base for tracking routine and special air, surface-water, soil, vegetation, wildlife, and foodstuff samples from the Hanford Site.

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The Waste Information Data System (WIDS) and the Hanford Inactive Site Survey (HISS) data bases were set up specifically to handle hazardous waste site information. The WIDS contains data on the general physical and environmental characteristics associated with the waste units located on the Hanford Site. The HISS contains Preliminary Assessment/Site Inspection (PA/SI) information on inactive sites at the Hanford Site including fairly detailed information on location, date for receiving waste, types and quantities of waste, cleanup actions, and other similar types of information. In addition, the HISS is supported by the PNL Hazard Ranking System (HRS) and Modified Hazard Ranking System (MHRS) Evaluation Data base, which contains the detailed HRS and MHRS scoring information, with input parameter justifications, for individual waste sites at the Hanford Site. The WIDS system serves as the official Hanford Site waste units identification and tracking system.

The Hanford Environmental Compliance Report (HECR) and Environmental Compliance Tracking System (ECTS) are two systems currently used at the Hanford Site to track compliance. The HECR was developed to provide a uniform method for Hanford Site contractors to use in collecting and maintaining regulatory compliance status information on Hanford Site facilities. Data input into HECR centers primarily around compliance with the various State and Federal legislation that may apply to a particular discharge point at the facility. The discharge point is the primary level for which compliance data are entered. However, the term "discharge point" can be defined with a great deal of flexibility allowing the system to track individual waste sites or operable units with no difficulty. The HECR provides for entry of additional compliance status information for those points needing follow-up action. This is done to allow tracking of compliance actions on a specific point. The ECTS contains regulatory flowsheet information. It is designed to be used in the evaluation of waste streams for compliance with Federal, State, and local environmental regulations. Waste streams are the primary focus of the ECTS; however, waste streams can be defined with some flexibility to allow the system to be used to track individual waste sites or operable units. The HECR and ECTS can be used in the comprehensive DMS to track compliance status of operable units (or individual sites if conditions warrant).

The Sample Preparation System (SPS) was set up to generate labels for sample bottles and to track sample status at the analytical laboratories. It can generate reports on samples collected, samples currently at an analytical laboratory, and samples with results overdue from the laboratory.

The BWIP Technical Data System (BTDS) was being prepared for the Basalt Waste Isolation Program (BWIP) to contain information on hydrological conditions and some geological data at the Hanford Site. The system was intended to handle data obtained from wells in hydrologic units in the basalt strata giving Lambert coordinates, water pressure, and other similar well information. It was also designed to handle site characterization, hydrological, hydrochemistry, stratigraphy, and constituent data. There is some overlap between the capabilities of the HGWDB and the BTDS. The BTDS is not intended for shallow wells in the unconfined aguifer.

The Warehouse Inventory Management System (WIMS) is a data base established to track, from receipt of material to its shipment to the customer, all stock items and to forward costing data to the Financial Data System. For the purpose of safe storage and transportation, hazardous materials are identified within WIMS. The system will be used in conjunction with the MSDS system and the SARA Title III program.

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The Flow Gemini - Environmental Information System, managed by the Hanford Environmental Health Foundation (HEHF), is commonly referred to as the HEX system. It is set up to contain information associated with onsite monitoring of exposures to hazardous materials of Hanford workers. This system is in the process of being modified, so there is considerable flexibility to adjust it to accommodate the onsite monitoring needs of the Westinghouse Hanford Environmental Restoration Program (ERP).

The Flow Gemini - Occupational Health Information System (HEHF's Medical Information Tracking System) contains the confidential employee medical evaluation and history information. The HEHF medical surveillance program will need to be given directions from the HASP for each operable unit as to the specific elements that will need to be tracked for the specific individuals involved with its characterization. Once this is done, the HEHF Medical Information Tracking System will contain all of this information.

The Material Safety Data Sheet (MSDS) system contains information on chemicals found at the Hanford Site. Currently, this is a manually operated system operated by HEHF; however, it is in the process of being computerized. The computerization effort is being done in coordination with the SARA Title III mandated "right-to-know" program at the Hanford Site.

The Occupational Radiation Exposure (ORE) data base system contains personnel respiratory protection fitting and qualifications, work restrictions, and radiation exposure information for all Hanford Site employees. Access to individual employee's records must be tightly controlled to comply with the Privacy Act.

The Quality Control Blind Standards Data base (QCBSDB) contains information associated with quality control spiked samples, replicate sampling, and interlaboratory comparison results for the Hanford Site RCRA program. The QCBSDB is currently a manually tracked system, but is in the process of being computerized. It can quite readily be expanded to handle these type of data for the ERP as well.

The Training Records Information System (TRIS) contains training records for Westinghouse Hanford employees. Currently it handles contractors to Westinghouse Hanford manually, but is in the process of being upgraded to handle these electronically. The TRIS can be adjusted to include all contractor personnel working on a particular operable unit.

The Financial Tracking System (FTS) contains financial records for tracking and reporting on status of projects at Westinghouse Hanford. It is the system Westinghouse Hanford uses to track the financial aspects of all their projects. It has the capability of tracking projects by cost accounts and can provide status reports upon request.

Chapter 4 of the March 1988 Review Draft of EPA's Office of Solid Waste and Emergency Response Directive 9355.3-01 "Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" addresses data management procedures. The contents of Table 4-2 of Section 4.2.1.3, which provides an outline of the file structure necessary for a superfund site, were used as a list of elements necessary for a data management system. Table 6-1 shows a listing of these elements and a brief discussion of how the various components of the DMS will address them.

The previous discussions have addressed the existing systems that can be used to provide a historical basis for the RI/FS work. However, there are several data-management needs identified in Table 2-1 for which there is no currently operated or historical data base. These include the following:

- Geophysical (site-by-site basis)
- Soil column analytical data (site-by-site basis)
- Pilot- and bench-scale testing
- ARAR screening

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- Cost tracking
- Calibration tracking
- Instrument coordination
- QA/QC tracking
- Field and laboratory notebook tracking
- Document tracking (both site specific documents and guidance documents)
- Treatment/alternative screening
- Summarized/analyzed data (involves most of the raw data types).

The Environmental Data Management Plan to be prepared by March 31, 1989 will address these needs. Initial development of HEIS will focus on these needs in the order listed.

Table 6-1. Analysis of Data Needs as Specified in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases (Sheet 1 of 3)

#### File structure/data needs

#### Applicable data bases

Congressional Inquiries and Hearings:
 Correspondence
 Transcripts
 Testimony
 Published hearing records

None available. These will have to be addressed by written procedures

Discovery:
Initial investigation
Preliminary assessment
Site inspection report
Hazard ranking system data

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Waste Information Data System and Hanford Inactive Site Survey. The Hanford Inactive Site Survey contains hard copy files of the information used for performing the Hazard Ranking System/Modified Hazard Ranking System evaluations of Hanford waste sites.

Remedial Planning:
Correspondence
Work plans for Remedial
Investigation/Feasibility
Study
Remedial Investigation/
Feasibility
Study Reports
Health and Safety Plans
Quality assurance/quality
control plans
Record of Decision/responsiveness summary

The Commitment Control System is presently available to track correspondence. Health and Safety plans and Quality Assurance/ Quality Control plans will be included in each Work Plan that will be developed for each operable unit. The information pertinent to the development of the Remedial Investigation Feasibility Study report will be tracked by HEIS using subordinate databases such as the Hanford Groundwater Data Bases, Program Data Management System, Waste Information Data Syste, Hanford Inactive Site Survey, Sample Preparation System, BWIP Technical Data System, Warehouse Inventory Management System, Flow Gemini-Environmental Information System, and Quality Control Blind Standards Data Base

Remedial implementation:
Remedial design reports
Permits
Contractor work plans and
progress reports
Corps of Engineers agreements
reports and correspondence

All of these items will be tracked by the Data Management System

Table 6-1. Analysis of Data Needs as Specified in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases (Sheet 2 of 3)

State and Other Agency
Coordination:
Correspondence
Cooperative agreement/
Superfund State contract
Interagency agreements
Memorandum of Understanding
with the State

Parts of these may be able to be tracked by Hanford Environmental Compliance Report. A record-file system is also currently being developed at the Hanford Site to track many of these items. These will be managed within the Data Management System.

Community Relations:
 Interviews
 Correspondence
 Community relations plan
 List of people to contract,
 e.g., local officials, civic
 leaders, environmental groups
 Meeting summaries
 Press releases
 News clippings
 Fact sheets
 Comments and responses
 Transcripts
 Summary of proposed plan
 Responsiveness summary

Interviews
Interviews
Correspondence
Community relations plan
List of people to contract, e.g., local officials, civic leaders, environmental groups

There is no known existing system at the Hanford Site available to electronically track community relations information can be handled manually in accordance with the community relations plan or tracking can be added to the Data

Management System if desired.

Imagery:
Photographs
Illustrations
Other graphics

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The Hanford Inactive Site Survey and associated files contain photographs and maps of sites. Also, the HEIS will have Graphic Information System (GIS) capabilities.

Enforcement:
Status reports
Cross-reference to any
confidential enforcement
files and the person to
contact
Correspondence
Administrative orders

The Hanford Environmental Compliance Report and Environmental Compliance Tracking System will be used to contain the compliance status information by operable unit. Any administrative orders that are formally produced can also be tracked in the Data Management System designed to track formal formal documents.

Table 6-1. Analysis of Data Needs as Specified in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases (Sheet 3 of 3)

#### Contracts:

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Site-specific contracts
Procurement packages
Contract status notifications
List of contractors

Other than existing project management software systems currently available at the Hanford Site, there is no known electronic system presently available to track contract information such as this. This information can be handled manually by procedures or the Data Management System can track it.

Financial Transactions:
Cross-reference to other
financial files and the
person to contact
Contractor cost reports
Audit reports

The financial operations for the clean up of a federal facility is different from the normal Environmental Protection Agency-funded Superfund process. The financial information that needs to be tracked for compliance purposes can be tracked manually or by the Data Management System.

# ATTACHMENT 5 PROJECT MANAGEMENT PLAN

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# CONTENTS

|          | 1.0 Introduction                                                                                    |
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#### 1.0 INTRODUCTION

The purpose of this Project Management Plan (PMP) is to define the administrative and institutional tasks necessary to support RI/FS activities in the 100-HR-I Operable Unit at the Hanford Site under CERCLA. This plan defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures.

The EPA, Ecology, and the DOE are entering into an agreement for remedial action on the Hanford Site. An action plan, which implements this agreement, defines EPA and Ecology regulatory integration and the methods and processes to be used to implement the agreement. This PMP is in accordance with the provisions of the draft action plan. Revisions to the action plan may result in changed requirements that would supercede the provisions of this plan.

#### 2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

# 2.1 INTERFACE OF REGULATORY AUTHORITIES AND THE U.S. DEPARTMENT OF ENERGY

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The 100-HR-1 Operable Unit consists of inactive waste management units to be remedied under the CERCLA, as amended by SARA. Therefore, it is under the authority of the EPA. The EPA has been designated as the lead regulatory agency as defined in the agreement. Accordingly, the EPA is responsible for overseeing remedial activity at this unit and ensuring that the applicable authorities of both EPA and Ecology are applied.

As lead regulatory agency, EPA will do the following:

- Assign an EPA Project Manager and a Unit Manager.
- Coordinate with Ecology as the support regulatory agency.
- Review and approve all primary documents prepared by DOE.
- Review and comment on secondary documents, if necessary.
- Evaluate DOE's responses to comments.
- Review and approve any action proposal by DOE.
- Draft the Record of Decision.
- Determine if an Interim Remedial Action (IRA) is required and request a proposed remedy from DOE, if necessary.

Ecology will be the support regulatory agency responsible for assigning an Ecology Project Manager and Unit Manager and for reviewing and commenting on all primary documents.

The DOE will do the following:

- Assign a DOE Project Manager and a Unit Manager.
- Prepare and implement the RI/FS Work Plan.
- Perform the Phase I and II RI and Phase I, II, and III FS.
- Prepare the RI/FS reports.
- Revise documents and respond to comments by the EPA and Ecology.
- Propose appropriate alternatives for an IRA, if required.
- Compile and maintain the administrative record.
- Upon issuance of the ROD, DOE will be responsible for preparing the Remedial Design Report (RDR), Remedial Action Work Plan (RA), and Operation and Maintenance Plan.

#### 2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization is shown on Figure 2-1. The following sections describe the responsibilities of the individuals shown on this figure.

Project Managers. The EPA, DOE, and Ecology will each designate one individual as project manager, who will serve as the primary point of contact for all activities to be carried out under the agreement and action plan. In addition, each of the above three parties will designate an alternate project manager. The primary responsibilities of the project managers are as follows:

- Implement the scope, terms, and conditions of the action plan.
- Direct and provide guidance to unit managers.
- Maintain effective communications among each other.
- Report project status to their respective management.
- Approve any changes to schedules in the work plan that will impact the work schedule contained in the action plan.

The DOE Project Manager will be responsible for maintaining a listing of the current unit managers.

Unit Managers. The EPA, DOE, and Ecology will each designate a unit manager for this RI/FS; the unit manager from EPA serving as the lead unit manager. The lead unit manager will be responsible for the activities required by the 100-HR-1 Operable Unit Area RI/FS work plan. The unit managers will represent their respective parties for these activities and are responsible for keeping their respective project managers informed on the work status, budget, and schedule, and of any problems that may arise.

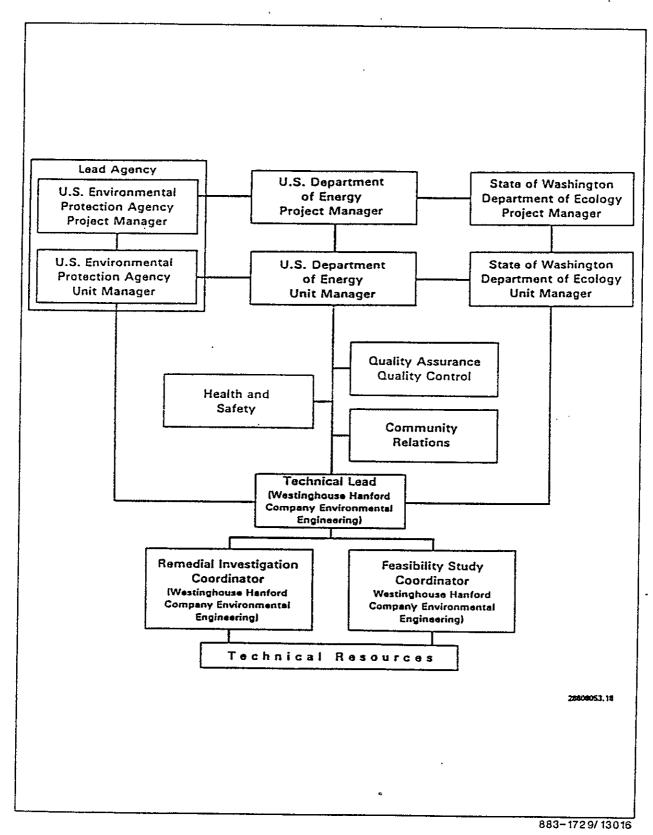
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Figure 2-1. Project Organization

Quality Assurance/Quality Control Coordinator. The quality coordinator is responsible for coordinating and/or oversight of performance to the QAPP requirements by means of internal auditing and surveillance techniques. The quality assurance officer retains the necessary organizational independence and authority to identify conditions adverse to quality and to inform the technical lead of needed corrective action.

Health and Safety Officer (Environmental Division/Environmental Field Services). The health and safety officer is responsible for determining potential health and safety hazards from radioactive, volatile, and/or toxic compounds during sample handling and sampling decontamination activities and has the responsibility and authority to halt field activities due to unacceptable health and safety hazards.

Technical Lead. The technical lead will be a designated person within the Westinghouse Hanford Environmental Engineering Group. The responsibilities of the technical lead will be to plan, authorize, and control work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound.

Remedial Investigation Coordinator. The RI coordinator will be responsible for coordinating all activities related to Phases I and II of the RI, including data collection, analysis, and reporting. The RI coordinator will be from the Westinghouse Hanford Environmental Engineering Group, and will be responsible for keeping the technical lead informed on the RI work status and any problems that may arise.

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Feasibility Study Coordinator. The FS coordinator will be responsible for coordinating all activities related to Phases I, II, and III of the FS, including data collection, analysis, and reporting. The FS coordinator will be from the Westinghouse Hanford Environmental Engineering Group, and will be responsible for keeping the technical lead informed on the FS work status and any problems that may arise.

Remedial Investigation Technical Resources. The various technical resources responsible for performing the RI are shown on Figure 2-2. These resources will be responsible for performing data collection, analysis, and reporting, for the technical activities related to the RI. Figure 2-3 through 2-7 show detailed organizational structure for specific RI tasks.

Internal and external work orders and subcontractor task orders will be written by the RI coordinator to use these technical resources, which are under the control of the technical lead. Statements of work will be provided that will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each group will keep the RI coordinator informed on the RI work status performed by that group and of any problems that may arise.

Feasibility Study Technical Resources. The various technical resources responsible for performing the FS are also shown on Figure 2-2. These resources will be responsible for identifying and screening remedial alternatives, and for detailed evaluation of selected alternatives. Work teams reporting to the technical lead for various phases and types of work are shown in Figures 2-3 through 2-7.

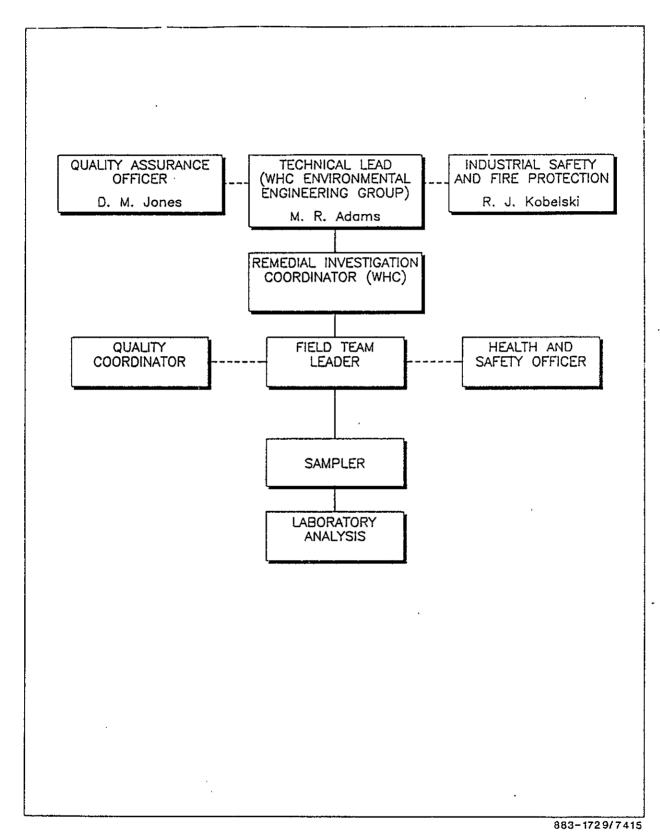
|                                                    | Technical resources                                                                                                                                                             |                                                                                      |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|                                                    | Remedial Investigation                                                                                                                                                          | Feasibility study                                                                    |
| Hydrogeology and<br>geology                        | Westinghouse Hanford/Geosciences PNUEarth and Environmental Sciences Center                                                                                                     | Westinghouse Hanford/<br>Geosciences                                                 |
| Toxicology and risk/<br>endangerment<br>assessment | Westinghouse Hanford/ Environmental Technology  PNL/Earth and Environmental Sciences Center  PNL/Life Sciences Center                                                           | Westinghouse Hanford/<br>Environmental Technology                                    |
| Environmental<br>chemistry                         | Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center                                                                                                    | Westinghouse Hanford/<br>Geosciences                                                 |
| Geophysics and field testing                       | Westinghouse Hanford/Geosciences (Planning) Environmental Field Services                                                                                                        | N/A                                                                                  |
| Geotechnical and civil engineering                 | N/A                                                                                                                                                                             | Westinghouse Hanford/<br>Environmental Engineering<br>PNL/Waste Technology<br>Center |
| Groundwater<br>treatment<br>engineering            | N/A                                                                                                                                                                             | Westinghouse Hanford/<br>Environmental Engineering<br>PNL/Waste Technology<br>Center |
| Waste stabilization<br>and treatment               | N/A                                                                                                                                                                             | Westinghouse Hanford/<br>Environmental Engineering<br>PNL/Waste Technology<br>Center |
| Surveying                                          | Kaiser Engineers                                                                                                                                                                | N/A                                                                                  |
| Soil and water<br>sampling and<br>analysis         | Westinghouse Hanford/Environmental Engineering Environmental Field Services PNL/Earth and Environmental Sciences Center PNL/Materials and Chemical Sciences Center U.S. Testing | N/A                                                                                  |
| Drilling and well installation                     | Westinghouse Hanford/Geosciences Environmental Field Services<br>Kaiser Engineers                                                                                               | N/A                                                                                  |
| Radiation<br>monitoring                            | Westinghouse Hanford/Operational Health Physics                                                                                                                                 | N/A                                                                                  |

\*Qualified subcontractors may conduct all or portions of the RI/FS.

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Figure 2-2. Technical Resources for Conducting RI/FS



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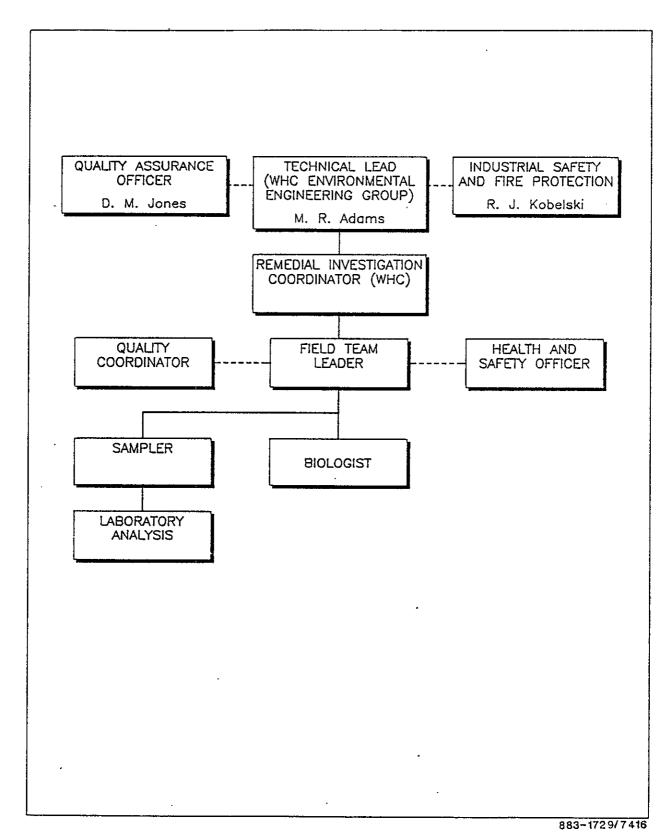
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Figure 2-3. 300-BP-1 Soil Sampling Team



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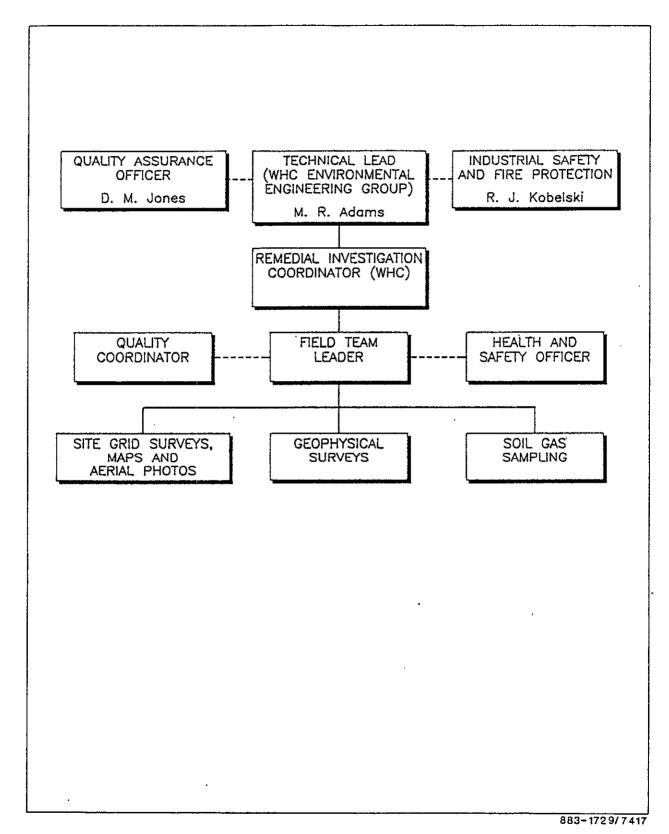
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Figure 2-4. 300-BP-1 Biological Sampling Team



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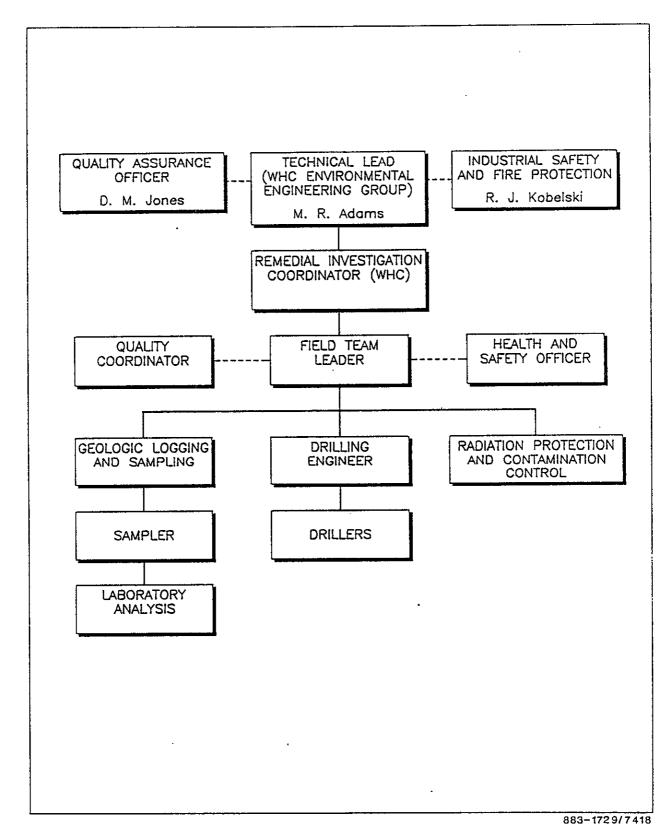
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Figure 2-5. 300 FF-1 Physical and Geophysical Survey Team



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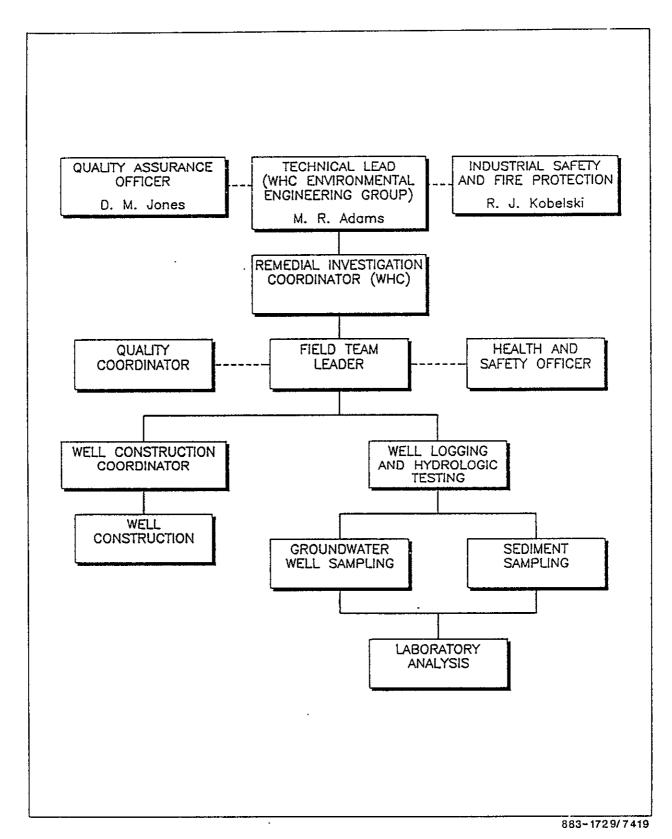
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Figure 2-6. 300-FF-1 Vadose Zone Drilling and Sampling Team



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Figure 2-7. 300-FF-1 Groundwater Well Construction and Hydrological Testing Team

Internal and external work orders and subcontractor task orders will be written by the FS coordinator to use these technical resources, which are under the control of the technical lead. Statements of work will be provided that will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each group will keep the FS coordinator informed on the FS work status performed by that group and of any problems that may arise.

### 3.0 REPORTING REQUIREMENTS

#### 3.1 CATEGORIZATION OF DOCUMENTS

All documents will be categorized as either primary or secondary. Primary documents, which are managed by EPA and DOE, represent the final documentation of key data and reflect decisions on how to proceed. Primary documents will be handled in accordance with standard Westinghouse Hanford procedures as quality records. Primary documents include the following:

• RI/FS work plan

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- RI Phase II Report
- FS Phase I and II Report
- FS Phase III Report
- Proposed Plan.

Secondary documents represent an interim step in a decision-making process or are issued for information and do not reflect key decisions. Secondary documents include the following:

- RI Phase I Report
- Sampling and data results
- Supporting studies and analyses
- Other supporting documents, as necessary.

#### 3.2 DOCUMENT REVIEW AND COMMENT

Primary Documents. Figure 3-1 provides the process flow for reviewing and commenting on primary documents. The flowchart reflects the multiple paths that a primary document may take depending on the type and extent of comments received. Figure 3-1 also designates the time periods, in terms of days, for specific actions.

All comments shall be submitted on a Review Comment Record (RCR) (Figure 3-2). The RCR will provide a record of the comment, together with the disposition, as agreed to by both the reviewer and the preparer. Comments may be made on all aspects of the document, including completeness, and should include, but are not limited to, technical adequacy and consistency with CERCLA or other pertinent guidance or policy. Where possible, comments shall be specific to individual lines, paragraphs, or sections. All comments shall be provided with adequate specificity so that DOE can respond in detail and make appropriate changes in the document. Reviewers shall indicate whether

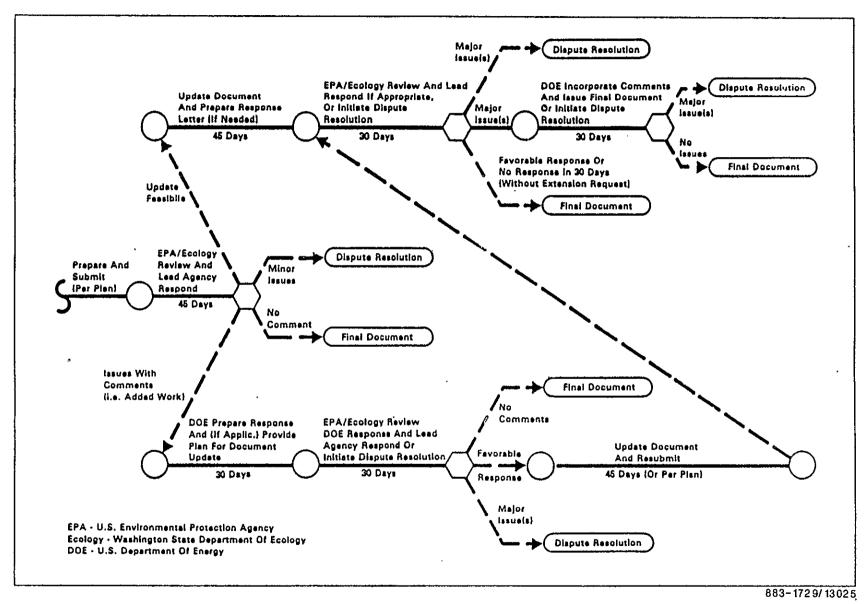


Figure 3-1. Review and Comment on Primary Documents

| L     | REVIEW C                                                                                                   | OMMENT RE                                  | CORD (RCR)                                 |                     |                 |             |            | 3 Project No       | 4 Page        |              |
|-------|------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------|-----------------|-------------|------------|--------------------|---------------|--------------|
| 5 Doi | umeni Humber(s)/Ticle(s)                                                                                   | 6 Program/Proje                            | stranging Howper                           |                     | 7. Reviewer     |             | & Organ    | nisation/Group     | \$ Location/F | none         |
|       |                                                                                                            | 10 Agreementy                              | with indicated comment                     | •                   | n(u)            | 11 0.05     | €D         |                    |               |              |
| 17 (4 | omment Submittal Approval                                                                                  | Date                                       | Aeviewe                                    | a i                 |                 | Dat         | •          | Acut               | wti           |              |
|       | REVIEWE                                                                                                    |                                            | Project/Cognitar                           | nt Engine           | н —             |             |            | Project/Cogni      | tant Engineer | _            |
| llem  | 13 Comment(s)Oncrepancy(s) (Provide technical justific recommendation of the action required to corrective | cation for the comm<br>solve the discrepan | nent and detailed<br>ty/problem indicated) | 14<br>Hold<br>Point | IS. Disposition | (brovide ju | ntificatio | nul HOT accepted). |               | 16.<br>Statu |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            | -                                          |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
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|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |
|       |                                                                                                            |                                            |                                            |                     |                 |             |            |                    |               |              |

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Figure 3-2. Review and Comment Record

they consider their comment to be mandatory (m), suggested (s), editorial (e), or clarification (c). Comments shall refer to any pertinent sources of authority or references upon which the comments are based, and, upon request of DOE, the commenting agency shall provide a copy of the cited authority or reference. In cases involving complex or unusually lengthy documents, EPA may extend the comment period for an additional period by written notice to DOE prior to the end of the first period. On or before the close of the comment period, EPA shall transmit their written comments by next-day mail to the DOE Unit Manager. Within one day of receiving EPA comments the DOE Unit Manager will transmit them to the technical lead.

Representatives of the DOE shall make themselves readily available to EPA during the comment period for the purpose of informally responding to questions and comments. Oral comments made during such discussions need not be the subject of a written response by DOE but will be addressed as appropriate.

In commenting on a draft document that contains a proposed "Applicable or Relevant and Appropriate Requirements" (ARAR) determination, the EPA shall include a reasoned statement of whether or not they object to any portion of the proposed ARAR determination. To the extent that the EPA does object, it shall explain the basis for its objection in detail and shall identify any ARARS that it feels were not properly addressed in the proposed ARAR determination.

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Upon receiving the comments from the EPA, DOE will update the document and/or respond to the written comments. The response will include a schedule for obtaining additional information if required. The DOE may extend the period for responding to the comments by obtaining written approval from the EPA.

Upon receiving the responses to the comments, the EPA will complete its evaluation of the response. In the event that the responses are inadequate, the matter will enter the dispute resolution process as set forth in Section XI of the agreement. The majority of the disputes are anticipated to be resolved during the initial informal dispute resolution period. Within 30 days of completion of the dispute resolution, or of the EPA evaluation of the responses if there is no dispute, DOE will incorporate the resolved comments into the document (see Part III of the agreement). The DOE may extend the 30-day period for revising the document by obtaining written approval of the EPA if the comments require additional information to be developed.

Upon receiving an updated document (with or without supporting responses), the EPA will determine if the document is adequate. If major issues still exist, the dispute resolution process will be initiated. If the document is adequate or if only minor modifications are necessary, the EPA will notify DOE in writting in which case the document will become final at the end of the 30-day period. If no such notice is received at the end of the 30 day period, the document will become final.

Secondary Documents. On secondary documents, EPA and Ecology have the option to provide comments within 45 days of submittal or take no action. Comments will be transmitted via RCR forms (Figure 3-2). If comments are provided, DOE will respond in writing within 30 days. The same criteria for review presented above for primary documents will be used for secondary documents.

However, secondary documents are not subject to the dispute resolution process.

## 3.3 REVISION OF PRIMARY AND SECONDARY DOCUMENTS

Following finalization, modification of primary or secondary documents may become necessary. Modification of a document shall be required only if the modification could be of significant assistance in: (1) evaluating impacts on the public health or the environment, (2) evaluating the selection of remedial alternative, or (3) protecting human health and the environment. Modification may require additional field work, pilot studies, computer modeling, or other supporting technical work. The following criteria must be met to revise a document:

- A party may seek to modify a document after finalization if it determines, based on new information (i.e., information that became available, or a condition that became known, after the document was finalized), that the requested modification is necessary. The party may seek such a modification by submitting a concise written request to the project managers. The request shall specify the nature of the requested modification and the new information on which the request is based.
- Consensus should be reached by the project managers on the need for the modification. In the event that consensus is not reached, any party may invoke dispute resolution to determine if such modification shall be conducted.

Nothing in this section shall alter the EPA's ability to request the performance of additional work that does not constitute modification of a final document. The review and comment process will be the same as the original document.

## 3.4 ADMINISTRATIVE RECORDS

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An administrative record shall be established to support the ROD. The administrative record file will contain all of the documentation used to arrive at the ROD. It will be available for public inspection when the investigation process begins. The administrative record file will be maintained in Richland. There will be two additional copies of the file: one will be at the EPA Region 10 Office and one at the Washington State Department of Ecology Office. The DOE will compile and maintain the file at Richland, and provide copies to EPA and Ecology for their respective files. The Administrative Record File will be initiated when the first document relating to the 100-HR-1 Area Operable Unit is submitted to EPA/Ecology. The contents of the file will increase as the process continues. When the decision document is signed, all documentation relevant to the selection of the final action(s) must be in the file.

The administrative record includes all primary and secondary documents. In addition, it will include the following:

All EPA, Ecology and Public comments on documents

All DOE responses to comments

Documentation of EPA and Ecology evaluation of the responses

 All documentation of dispute resolution activities, including correspondence and final resolutions.

## 3.5 DISTRIBUTION OF DOCUMENTS AND CORRESPONDENCE

Table 3-1 indicates the appropriate distribution of all documents and correspondence. In general, any correspondence or documents relevant to the evaluation and selection of a remedial alternative will be included in the administrative record.

#### 3.6 CHANGE CONTROL

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This section provides the process for modifying the work schedule in the work plan, as well as minor field changes, without having to process a formal revision as described in Section 3.3 above.

Authority to Approve Changes. Project manager approval is required on all changes to the work plan schedules that impact the work schedule contained in the action plan as described in Section 2.2. Changes to the work plan schedules that do not impact the action plan can be approved by the unit managers.

Formal Change Control Process. Changes to the work plan schedule, including those that impact the work schedule in the action plan shall be processed using the change control sheet included as Figure 3-3.

Changes are tracked by a "change number." The DOE shall maintain a log of all changes by number and title, along with a file copy of the change. An individual will be assigned responsibility for maintaining the change file and will be responsible for assigning change numbers. The change number can be obtained any time during the change process, even after the change is approved.

The change control form should include a short title for the change, which will be used primarily as a cross-reference on the change log. It should also provide a description of the change, along with justification as to why the change should be made and should briefly explain the likely consequences if the change is not made. All documents that will have to be revised because of the change shall be listed.

Once approved, the change is considered implemented. The work schedule in the action plan or the work plan schedule need not be updated until its next scheduled update.

Field Changes. With exception of minor field changes, revisions to specified technical requirements and design will be made through revision of the technical documents in which they are presented. Minor field changes are those that do not affect established requirements (i.e., ARARs) or that do not degrade the level of investigation, monitoring, or cleanup. Examples of minor

Table 3-1. Distribution of Documents and Correspondence

|                                      | Not affecting decisions on remedial actions                | Affecting decisions on remedial actions                    |
|--------------------------------------|------------------------------------------------------------|------------------------------------------------------------|
| Unit manager's correspondence        | Unit managers for that operable unit at other two agencies | Unit managers for that operable unit at other two agencies |
|                                      | Project managers at all three agencies                     | Project managers at all three agencies                     |
| •                                    |                                                            | Administrative Record Files                                |
| Project manager's correspondence     | Project managers at other two agencies                     | Project managers at other two agencies                     |
|                                      | Affected unit managers                                     | Administrative Record Files                                |
| Draft primary or secondary documents | Unit managers for that operable unit at all three agencies |                                                            |
| Final secondary documents            | Project mangers at all three agencies                      | NA                                                         |
|                                      | Administrative Record Files                                |                                                            |
| Final primary documents              | NA                                                         | Unit managers for that operable unit at all three agencies |
|                                      | ,                                                          | Project managers at all three agencies                     |
|                                      |                                                            | Administrative Record Files                                |
| Quarterly Reports                    | Unit managers for that operable unit at all three agencies | Unit managers for that operable unit at all three agencies |
|                                      | Project mangers at all three agencies                      | Project managers at all three agencies                     |
|                                      | Administrative Record Files                                | Administrative Record Files                                |
|                                      |                                                            |                                                            |

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| ss of Change:  I I-PM's Supervisor  III-Project Manager  CHANGE TITLE:  Description/Justification of Change:   [Impact if Change Not Made:  [Impact if Change Not | Change Number:               | ACTION PLAN CHANGE CONTROL SH<br>(ECOLOGY, EPA, DOE AGREEMEN |                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------------|-----------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |                                                              |                       |
| CHANGE TITLE:  Quescription/Justification of Change:  [Impact if Change Not Made:  [Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              | II-Project Manager                                           | )  — III-Unit Manager |
| Description/Justification of Change:  (a)  (b)  (c)  (d)  (d)  (d)  (e)  (fected Documents: (List Specific Documents)  (d)  (e)  (fected Documents: (List Specific Documents)  (fected Documents: (List Specif |                              |                                                              |                       |
| ffected Documents: (List Specific Documents)  7  pprovals:  8  Department of Energy Date  Ecology Date  9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |                                                              |                       |
| Impact if Change Not Made:  (6)  Iffected Documents: (List Specific Documents)  (7)  Poprovals:  (8)  Department of Energy  Date  (9)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |                                                              |                       |
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Figure 3-3. Change Control Sheet

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field changes include revision of sampling locations, additional sampling as required, and operational decisions required to accommodate actual field conditions.

To ensure efficient and timely completion of tasks, minor field changes can be made by the field team leader in accordance with Westinghouse Hanford procedure, "Deviation from Environmental Investigation Instruction." Such changes will be documented in the daily log books that are maintained in the field in accordance with Westinghouse Hanford procedure, "Field Logbooks." If such field change is anticipated to affect the schedule, the DOE Unit Manager will then be notified so that a change control sheet can be processed for the schedule change.

## 4.0 FINANCIAL AND PROJECT TRACKING REQUIREMENTS

#### 4.1 MANAGEMENT CONTROL

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Westinghouse Hanford will be responsible to plan and control activities and to provide effective technical, cost, and schedule baseline management. The Westinghouse Hanford Management Control System (MCS) will be used for effective planning and control practices. The MCS meets the requirements of DOE Order 4700.1, Project Management System (DOE 1987) and DOE Order 2250.1B, (DOE 1985) Cost and Schedule Control Systems Criteria for Contract Performance Measurement. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The work plan schedule and major milestones are described in Section 6.0 of the 100-HR-I Operable Unit work plan. The work plan schedule will be the primary vehicle for the unit and technical leads to track progress. The work plan schedule must be consistent with the work schedule contained in the action plan for implementation of the agreement.

The work plan schedule will be updated at least annually, with the primary purpose to expand the new current fiscal year and follow-on year. In addition, any approved schedule changes (see Section 3.6 for formal change control system) would be incorporated at this time, if not previously incorporated. This update will be performed in the fourth quarter of the previous fiscal year (e.g., July to September) for the upcoming current fiscal year. The work schedule can be revised at any time during the year if the need arises, but would be restricted to major changes that would not be suitable for the change control process.

#### 4.2 MEETINGS AND PROGRESS REPORTS

Project Managers Meeting. The project managers shall meet, at a minimum, on a quarterly basis to discuss progress, address issues, and review plans for the next quarter. A status of the work schedules from selected RI/FS work plans will be reviewed at the meeting and will include any supporting technical

information. Any agreements and commitments resulting from the meeting will be prepared and signed by all parties prior to the conclusion of the meeting.

Unit Managers Meeting. The Unit Managers shall meet at least monthly to discuss work progress, address technical issues, and review near-term plans. The DOE Unit Manager will prepare a monthly status report on the schedules of all ongoing activities from the RI/FS Work Plan prior to the meeting. The schedule status report will be provided by DOE to all parties and reviewed at the meeting. Any agreements and commitments (within the unit managers level of authority) resulting from the meeting will be prepared and signed by all parties prior to the conclusion of the meeting. The DOE Unit Manager shall issue the meeting minutes to all parties, with information copies to the project managers, within five (5) working days following the meeting. The minutes will include, as a minimum, the following:

- Status of previous agreements and commitments
- Description of agreements and commitments resulting from meeting
- Work schedule status

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 Any approved changes signed off at the meeting in accordance with Section 3.6 of this Project Management Plan.

Quarterly Progress Report. The DOE shall issue a quarterly progress report to the EPA and Ecology within 45 days following the end of the quarter being addressed for all ongoing work associated with the agreement and action plan. The issuance of these reports will be shown on the action plan. The report shall include the following:

- Highlights of significant progress and problems
- Technical progress, with supporting pictures as appropriate
- Problem areas with recommended solutions
- Significant activities planned for next quarter
- Work schedule status.

Following issuance of the report to the EPA and Ecology, it will be placed in the public reading room for public access.